SCIENTIFIC AMERICAN SUPPLEMENT. No. 978

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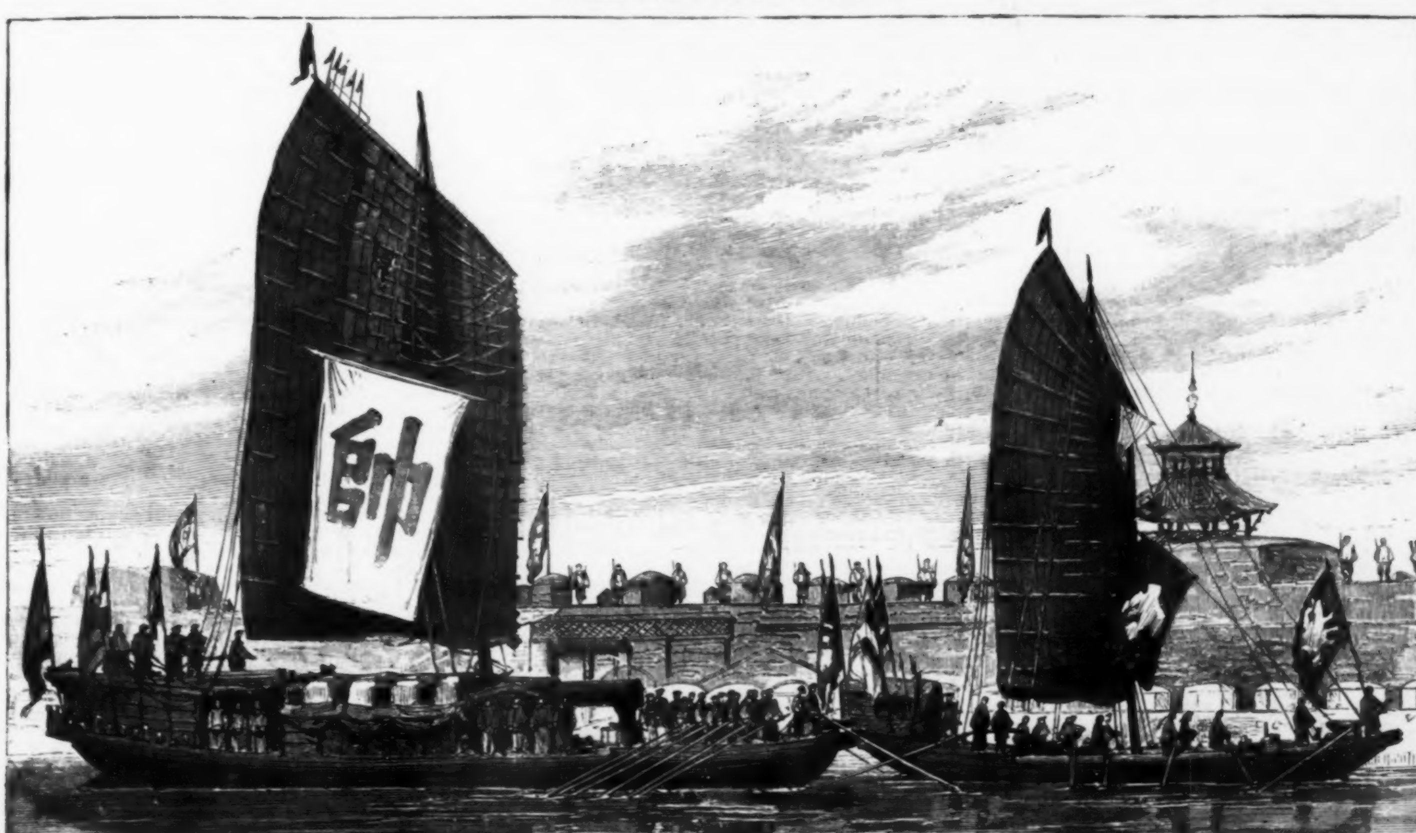
Scientific American Supplement, Vol. XXXVIII. No. 978. Scientific American, established 1845. | NEW YORK, SEPTEMBER 29, 1894. | Scientific American Supplement, $5 a year. Scientific American and Supplement, $7 a year.

GENERAL SHAN. THE LATE PRINCE CH'UN. LI HUNG CHANG.

THREE GREAT MEN OF CHINA.



CHINESE PRIME MINISTER, LI HUNG CHANG, VICEROY OF CHIH-LI, GOING IN HIS STATE BARGE FROM TIENTSIN TO PAO-TING-FU.

THREE GREAT MEN OF CHINA.

OUR illustration represents three eminent state servants of the Chinese empire. They are Chinese, at least by citizenship, though the two warriors seated, one in the center, the other to the left, are of Manchu birth. The central figure is the late Prince Ch'un, who was the chief agent, in concert with Li Hung Chang, in promoting the present modernized improvement of the Chinese army and navy. Prince Ch'un, who has now been dead some years, was a "Ch'in Wang," or prince of the imperial blood. General Shan, on the left hand side of the group, is a prominent "Chiang-chuen," or Tartar general. He is commandant of one of the Manchu Banner Corps at Pekin.

To the right is seated one who has been frequently styled, with some justice, the "Bismarck of China"—the Viceroy of Chihli, Li Hung Chang, Grand Councilor of the Empire and Guardian of the Heir Apparent. Li Hung Chan's name has been prominently before the public of late in connection with the war with Japan. He was recently stripped of the most coveted distinction it is in the power of the Emperor of China to bestow—the Order of the Yellow Riding Jacket, or, as it is called in Chinese, the "Huang ma-kua." But those acquainted with the tortuous methods of Chinese government know that this reproof was administered rather to spur the great viceroy to more vigorous efforts than to disgrace him. The three officials are in the ordinary winter dress of Chinese government servants.

The Viceroy of Chihli, Li Hung Chang, appears in a separate illustration, making a progress, in the viceregal state barges, from Tientsin, his usual place of residence, to Pao-ting fu, the capital of the province. The Chinese character on the sail signifies the leader or general.—Illustrated London News.

THE CHINESE ARMY.

THE improvement of military equipment said to have been made in China since the French war of 1884 and 1885 has in the opinion of the Hon. G. N. Curzon, M.P., whose new book, "Problems in the Far East," should be consulted with reference to the present war with Japan, been noticed "with much premature congratulation."

The nominal strength of the "Eight Banners," forming the imperial army, is returned, differently according to estimated deductions, at from 230,000 to 330,000 men. But this author says that "considerably less than 100,000, perhaps not 80,000, are, in any sense of the term, upon a war footing. The best of them, amounting to an army corps 37,000 strong, are stationed in Manchuria, where, face to face with the dreaded enemy, Russia, large garrisons are maintained at Moukden, Kirin and along the Ussuri. The imperial guard at Pekin, which is drawn from the Banner Army, consists of eight regiments, or 4,000 to 6,000 men.

"Side by side with them is the Ying Ping, or National Army, called in contradistinction the Green Flags, or Five Camps (five being the unit of subdivision), and constituting a territorial army, frequently designated as 'Braves.' Of this army there are eighteen corps, one for each province of the empire, under the orders of the local governor or governor-general. Their nominal strength is given by different authorities as between 540,000 and 660,000 men, of whom 170,000 to 250,000 are variously reported to be available for war. The National Army is, in fact, better described as a militia, about one-third of whom are usually called out, and the whole of whom are never organized, and are probably incapable of being organized, for war. To this force must be added the mercenary troops, raised in emergencies, and dating from the time of the Taiping rebellion, and some irregulars, consisting of Mongolian and other cavalry, nominally 200,000 in number, in reality less than 20,000, and of no military value.

"The only serious or formidable contingent of the National Army is the Tientsin army corps, called Lien Chun, or drilled corps, which was first started, with European officers, after the war of 1860, and acquired its cohesion in the suppression of the Taiping rebellion; since which it has been maintained in a state of comparative efficiency by the Viceroy, Li Hung Chang, its organization and instruction being based on the Prussian model. Nominally, this division is 100,000 strong; but its mobilized strength is not more than 35,000, or a full army corps, which is employed to garrison the Taku and Peitang forts, the city of Tientsin, and Port Arthur. It is sometimes called the Black Flag Army, and is equipped with modern firearms, breech-loading Krupp guns, and Snider, Hotchkiss, Remington, and Mauser rifles. The pay is also superior to that of the Banner Army; for whereas, in the latter, a cavalry soldier receives only ten shillings a month and forage allowance, and the foot soldier seven shillings a month and rations, the Tientsin private receives fifteen shillings a month. If any real business requires to be done in the metropolitan province or neighborhood, it is to the Tientsin contingent that recourse is made.

"This is the total land army of China—on a peace footing not more than 300,000, on a war footing about one million men—that is called upon to garrison and defend an empire whose area is one-third of the whole of Asia, and half as large again as Europe, and whose population is half of the total of Asia, and equivalent to the whole of Europe."

The metropolis of the vast Chinese empire, the city of Pekin, is situated not very far from its northern frontier and from the Great Wall, anciently built to keep out the Tartar invasions. But it was founded in the thirteenth century, by the Mongol ruler, Kublai Khan, grandson of the conqueror, Genghiz Khan; and under the present reigning dynasty, which is of Manchu origin, its aspect is not of a purely Chinese character, like some great cities of the southern provinces. Illustrations of Pekin were given from the sketches by our special artist, Mr. W. Simpson, who twenty years ago went there upon the occasion of the marriage of the late Emperor Tung Chih, succeeded not long afterward by his present Imperial Majesty, Kuang Hsu. Eighty miles to the southeast of the capital, on the Peiho River, and nearer to the coast of the Gulf of Pecheli, is the important city of Tientsin, the headquarters of the provincial government of Chih-li, under the immediate rule of the Viceroy, Li Hung Chang, who is also Grand Secretary of State for the empire. Tientsin was captured, not without much difficulty, by the allied British and French military forces, assisted by the fleets, in the war of 1859 and 1860. The first naval attack on the Taku forts, at the mouth of the river, was by no means a successful affair, the ships becoming entangled among the mudbanks and helplessly exposed to the Chinese batteries on shore. There is now a railway to Tientsin. A military school has been formed at Pekin; and schools of gunnery, musketry, and engineering, under the patronage of Li Hung Chang, at Tientsin.—Illustrated London News.

THE WAR BETWEEN JAPAN AND CHINA.

THE peninsula of Corea, although connected with the main land of China, is, nevertheless, a near neighbor to Japan, and for many years the commerce and intercourse between Corea and Japan has been growing, until of late it has assumed proportions of great importance.

From time almost immemorial China has pretended to hold Corea as one of her dependencies, but in truth the peninsula has always possessed an independent government, her king, her laws, her administration, the manners and customs of the people being very different from those of China.

The independence of Corea has long been recognized by Japan, but this the Chinese government have of late decided to dispute, and the two nations have sought to establish their respective claims by arms, and by the occupation of the Corean territory by military and naval forces. Seoul, the capital of Corea, is in possession of the Japanese. China has sent large bodies of troops down into Corea to expel the Japanese. On the 15th and 16th of September a great battle took place at Ping Yang, some distance north of Seoul, which resulted in favor of the Japanese.

At three o'clock on Sunday morning an attack was made by the Japanese columns simultaneously and with admirable precision. The Chinese lines, which were so strong in front, were found to be weak in the rear, and here the attack was a perfect success. The Chinese were completely taken by surprise, and were thrown into a panic. Hundreds were cut down, and those who escaped death, finding themselves surrounded at every point, broke and fled. Some of Viceroy Li Hung Chang's European drilled troops stood their ground to the eastward, and were cut down to a man.

It is estimated that 20,000 Chinese soldiers were engaged in the battle. The Japanese captured immense stores of provisions and munitions of war and hundreds of colors. The Chinese loss is estimated at 16,000 killed, wounded, and taken prisoners. Among those captured by the Japanese are several of the Chinese commanding officers, including General Tso-Fung, commander in chief of the Manchurian army, who was severely wounded. The number of the Chinese who were killed is estimated at 2,300.

The Japanese loss is only 30 killed and 270 wounded, including 11 officers.

COREA: ITS CAPITAL AND PEOPLE.*

"WHAT is the use of working and making money," said once a Corean to me, "if, when the work is done and the money made, this is taken away from you by the officials, and you are worn out for having done the work, and as poor as before? if, mind you, you are fortunate enough not to be exiled to a distant province by the angry magistrate who has enriched himself at your expense. Now," added the Corean, looking earnestly into my face, "would you work under those circumstances?" It is really painful, when you first land in Corea, to notice the careworn, sad expression on everybody's face. There they lie about, idle and pensive, doubtful as to what will happen to them to morrow, all anxious for generations that a reform might take place in the mode of government, yet all for centuries too lazy to attempt to better their position. The lower classes in Corea are much given to fighting, and the slightest provocation—in money matters—is sufficient to make them come to blows. With one hand they catch hold of each other by the knot in which the hair of all married men is tied on the top of the head, and while a violent process of head shaking is followed by a shower of blows and scratches administered by the free hand, the lower extremities are kept busy distributing kicks.

Seoul, the capital of the Corean kingdom, is the only city where wide streets are found, and the main street, leading to the royal palace, is indeed immensely wide, so much so that two rows of smaller thatched houses and shops are built in the middle of the street itself, thus forming, as it were, three parallel streets of one street; but these houses are removed and pulled down twice or three times a year, when his majesty the king chooses to come out of his palace and goes in his state chair either to visit the tombs of his ancestors some miles out of the town, or to meet the envoys of the Chinese emperor, a short way out of the west gate of the capital, and at a place where a peculiar sort of triumphal arch, half built in masonry and half in lacquered wood, has been erected, close by an artificial cut in the rocky hill, which, in honor of the Chinese messengers, goes by the name of the "Pekin Pass." All the cities in Corea are walled, and the gates are opened at sunrise and closed with the setting sun. I well remember at Seoul how many times I have had to run so as not to be locked out of the town; and vivid before me is yet the picture of hundreds of men, women, and children, on foot or on tiny ponies, or leading laden bulls, scrambling to get in or out while the "big bell" in the center of the town announced with its mournful sound that with the last rays of light the heavy wooden gates lined with iron would be again closed till the morning. With the sun every noise ceased, every good citizen retired to his house, and only an occasional leopard now and then crawled over the city wall, making peregrinations in the darkness over the capital. The little trade, consisting mostly of grain exportation, is carried on almost entirely by Japanese and Chinese, while the importation of cotton and a few miscellaneous articles is done by an American and a German merchant. The post office is in the hands of the Japanese, the telegraphs are under the control of the Chinese, as well as the customs revenue, which is looked after by officials in the Chinese service. Chemulpo is a picturesque harbor, but the water too shallow to allow very large ships to enter it.

Coreans are not much given to washing, and less still to bathing. They wash their hands fairly often, and occasionally the face; the better people wash it almost daily. Corean houses are generally small, and the rooms of diminutive size. The most curious point about them is that the flooring is made of stone covered with oil paper, and that under the stone flooring there is a regular oven, called "Kan," in which a big fire is kept up day and night. Often, as the people sleep on the ground in their clothes, it happens that the floor gets so hot as to almost roast one. The Coreans seem to delight in undergoing this roasting process, and when well broiled on one side they turn on the other, and take it quite as a matter of course.

The king's palace until lately was little better than the houses of other people, except that in the grounds he had a grand stone building which he calls the "Summer Palace," but which he only inhabits on state occasions. When the king goes for a day out of the palace grounds, it is a great event in Seoul; the troops are summoned up, and line each side of the road leading to the palace. It is indeed a strange sight to see, in these days, soldiers in armor and carrying old fashioned spears, and with their wide-awake black hats with a long red tassel hanging down on the shoulders; but stranger still they look in rainy weather, when a small umbrella is fastened over the hat. The cavalry soldiers still retain their old uniforms, while the infantry have a sort of semi-European costume which is quite comical to look at. The Coreans, it must be understood, are lazy and depressed, but they are by no means stupid. I have come across people there who would be thought marvelously clever in any civilized country; and when they wish to learn anything, they are wonderfully quick at understanding even matters of which they have never heard before. Languages come easy to them, and their pronunciation of foreign tongues is infinitely better than that of their neighbors the Chinese or the Japanese.

* Mr. A. Henry Savage-Landor, in the Fortnightly Review.

JOSEPH NEEF: A PESTALOZZIAN PIONEER.

By A. CARMAN.

THE Hon. George S. Boutwell, in the November number of the Popular Science Monthly, referred to a recent article by Prof. W. W. Aber on the Oswego State Normal School, in which is claimed for that school the credit of introducing into this country the Pestalozzian system of teaching. The Oswego School was founded in 1853, and Mr. Boutwell says that from about the year 1839 this "art of teaching was taught" in the Massachusetts State Normal Schools.

While the first schools for teachers of the Pestalozzian system may have been in Massachusetts, Pennsylvania may yet claim the credit of having the first Pestalozzian school for children in America. It was established in 1809 by Joseph Neef, at a spot then called the Falls of the Schuylkill, some four miles from the old city of Philadelphia, now part of Fairmount Park.

Francis Joseph Nicholas Neef was born in Soultz, Alsace, December 6, 1770. He was educated for the Roman Catholic priesthood, but at the age of twenty-one, when about to take orders, he gave up the idea of entering the church, as not being at all suited to his tastes. He entered the French army under Napoleon, attaining high rank therein, and in the battle of Arcola was severely wounded in the head by a spent ounce ball, which he carried to the day of his death, a period of over fifty years. After leaving the army he became teacher of languages in Pestalozzi's celebrated school at Burgdorf, Switzerland, where he remained for some years, being then sent by Pestalozzi to Paris at the request of a philanthropic society whose attention and interest had been attracted to the good work being done at Burgdorf.

During Neef's stay in Paris, Mr. William Maclure, an American patron of education, science and philanthropy, visited Pestalozzi's school, which had by that time been moved to Yverdun. Mr. Maclure was so favorably impressed by the rational methods employed in this school that he conceived the generous idea of establishing a similar institution near Philadelphia, where he was then living. Pestalozzi recommended to him his former coadjutor, Joseph Neef, as a man thoroughly imbued with his principles and well fitted to introduce them into the western world. Neef, when approached on the subject, hesitated, for, though master of eight languages, he was ignorant of the English. Persuaded, however, that he could soon overcome this difficulty, he came to America, and such was his success that within a year he published a work of one hundred and sixty-eight pages in the English language, with the following descriptive title: Sketch of a Plan and Method of Education founded on an Analysis of the Human Faculties and Natural Reason, Suitable for the Offspring of a Free People, and for all Rational Beings. By Joseph Neef (formerly a Coadjutor of Pestalozzi, at his School near Berne, in Switzerland). Philadelphia, 1808.

This work is faultless as to grammatical construction, and was the first strictly pedagogical work published in the English language in this country. It would interest any modern teacher who has read the numerous pedagogical works of to-day to give this quaint little volume a careful perusal. There are now but half a dozen known copies in existence, one being in the State Library at Indianapolis. Another work, Method of Teaching Children to Read and Write, was published by him in 1813.

Neef had in the school established at the Falls of the Schuylkill about one hundred pupils, most of them boarders, who were taught physiology, botany, geology, natural history, languages, mathematics, and other branches, without the aid of a single text book, a purely natural method being followed. "Neef's boys from the Falls," as they were known to Philadelphians, could, without exception, after being in the school for a short time, work mentally the most

difficult examples in arithmetic, converse with equal ease in several languages, and many who were his pupils have said in after years that the amount of scientific information and practical knowledge gained while under Neef's care had always been of incalculable benefit to them.

In 1813 he removed to Village Green, in Delaware County, Pennsylvania. David Glasgow Farragut was one of his pupils at that place. From here the school was moved to Louisville, at the earnest solicitation of several Kentucky patrons. In 1826, when Robert Owen, of New Lanark, Scotland, began his famous socialistic experiment at New Harmony, Indiana, Mr. Neef took charge of the educational department of his community. In 1828 the community ceased to exist, and Mr. Neef removed to Cincinnati, and later to Steubenville, Ohio, where he engaged in his last school. He died at New Harmony in 1853.

The following extract is taken from his book published in 1808: "The man of refined morality feels it to be his duty not only to be good, but also to inquire in what situation and through what means he may be able to produce the greatest sum of good to his fellow-creatures. It is my ambition and duty to become a useful member of society. The education of children and the rearing of vegetables are the only occupations for which I feel any aptitude. I have, therefore, seriously inquired in which of these two spheres I should produce the greatest advantage to the society of which I may become a member, whether by clearing and tilling some secluded spot of land, or by cultivating the pretty bewildered field of education. After mature deliberation, I became fully convinced that in the latter capacity my faculties will be more likely to be beneficial to my fellow-creatures. These are my reasons for appearing as a teacher, or rather educator."

Mr. Neef left no male descendants, but two married daughters are still living in this country.—Popular Science Monthly.

DR. FLINDERS PETRIE'S EXCAVATIONS AT KOPTOS, EGYPT.

Dr. Petrie has already pursued researches at more than one site selected with some special object. Thus the work of the year before last was at Medum, in order to discover if there were traces of very early sculpture and work anterior to that of the Twelfth Dynasty, which he had previously investigated at Kahun. The excavations produced evidences that the pyramid was the work of Seneferu; and the small temple found in front of it proved to be the work of the same king—one of the most ancient little buildings remaining in the mysterious land of Egypt, and one of the most perfect. We may express gratification at the fact that, to save this little treasure of ancient work from the searchers for building stone, it was again covered over with the excavated earth.

The exhibition of last year revealed the peculiar art to be found at Tell-el-Amarna, and nowhere else in Egypt. The buried heaps of the city founded by Khuneaten and destroyed by his immediate successors were excavated, and a new page of Egyptian art was revealed, showing a naturalistic school of design which appears to have sprung into existence and to have disappeared with the short-lived king.

The researches which have produced this year's exhibition were undertaken with a clearly defined object. It was to discover, if possible, traces of the earliest works of the Egyptian race, and to throw light upon the question as to whence the people came, and when.

In the dim traditions of the past, and in more than one inscription, the holy land of Punt is referred to, wi h the belief, strengthened by many ethnological evidences of race, of language, and of arts, that this land lay to the east, and that the people, like so many others, journeyed away from the east, westward. There is a small town, marked on the maps variously as Keft or Koft, which many a traveler has passed by without thinking it worthy of staying his course to Thebes to investigate, and which, from the time of Norden to our own, hardly comes in even for notice beyond that of the mere name, even if this is mentioned. And yet this town, if the name can be given to the small group of poor-looking dwellings which at present forms it, has played an important part in the history of Egypt. It stands about twenty-five miles away from the once huge metropolis of Thebes, on the east bank of the Nile, and from it the main roads across the Eastern desert branched out, one proceeding almost directly east to the ancient town on the banks of the Red Sea now represented by Kosseir, and another going southeast to the sheltered but far off port of Berenice. One or other of these ancient routes, used so constantly as a means of communication between Egypt and the Eastern world beyond, was likely enough to be the way by which the earliest immigrations were made into the land. But where is Punt? Is it merely the arid deserts of Arabia on the opposite side of the Red Sea? or is it the more congenial land of Persia beyond it? Or is it India? Certain, however, it is, that the earliest races, as apart from what appear to be the aborigines, have been recognized by attributes which speak of Semitic origin; and their love of the arts and their intelligence have already been alluded to.

The modern town is known to have been the site of the ancient Koptos, and here, where the roads from the seaboard terminated, Dr. Petrie determined to devote his energy, considering that here, the first point where immigrants from the east would come upon the waters of the Nile, would be perhaps the most likely spot for their first settlement to be made. Abydos is known to be a site of very early foundation, but it is far more to the north, and likely therefore to have been occupied in later years, after the first arrival of the incoming race, when they had so far mastered the land and developed themselves. At Koft was the well-recognized sight of a temple, robbed all but entirely of its stonework by the villagers, but not yet ransacked by that enemy of all knowledge, the modern digger of antiquities merely for commercial purposes.

The temple site, being the one special object in the town likely to indicate the best traces of ancient times, was selected in preference to any other, and it has been thoroughly excavated during eleven weeks of hard work in the manner peculiar to Dr. Petrie, who never leaves any object uninvestigated. The excavations have yielded important results, fully justifying the choice of the site, and the objects found have been made to tell their history, not only by their inscriptions and other evidences, but by the positions in which each object was discovered having been carefully noted.

A huge length of sun-dried bricks, shorn of its face work, proved to be the south wall of inclosure of the ancient city. Within the inclosed area of the town, and about 400 feet from the wall to the east, are the remains of the great temple. The excavations have determined its ground plan. With walls in some cases 25 feet thick, it measured 322 feet from east to west and 218 feet from north to south, internally, the walls being formed of sun-dried brick. The axis, to be exact, however, is 9 degrees north of east. To the west outside the inclosing walls, and between them and the town wall, distinct traces were met with of three pylons, or entrance gateways, in addition to a fourth in the wall of the town itself. Two of these were in line with each other from north to south, like two gateways in the same wall. In front of the great temple were traces of three flights of steps, of different dates, and of a front of later workmanship, of the time of the Ptolemies. It was wisely determined to excavate the whole of the area of the site, especially of the space within the temple walls. The pickax and spade speedily revealed traces of other buildings within the inclosing area, which latter itself proved to contain a larger area than had at one time been the case, for walls of the same date as the front, built of sandstone, were found within them on three sides, arranged close to them, but just a little only out of parallel. Within the temple inclosure, the progress of the excavations revealed the outline of the temple proper, situated in a position not central with either sets of the inclosing walls, and nearer to the west than to the east.

The traces of the walling were not very distinct, but the building appears to have measured 97 feet from east to west, with a width of 70 feet. There were no traces left as to how this wide space had been roofed over, which is somewhat extraordinary, supposing that the temple had followed the usual arrangement in being covered over. The absence of traces either of columns or of their masonry foundations suggests the supposition that, if roofed at all, it was by timber supports and beams. A large mass of walling, it is true, was found just within the west front, but in no symmetrical position, and no corresponding mass was found on the south side. A curious discovery was made when the excavations reached the northeast angle. Here traces of a limestone pavement were found, of irregular-sized blocks, fitted badly to each other. These were taken up, and were found to be facing slabs of earlier work, covered with sculptures. On being freed from their mortar bedding, they proved to be of the time of Antef V., and part of the temple built by him. It was evident that at a very early date, most probably on the recorded rebuilding of the temple during the twelfth dynasty, these slabs were all removed, and used as paving stones. Thus they remained during the many centuries that have elapsed since they were laid until they were discovered last winter. Beyond the temple, to the east, was found, on the north side, the jamb of a door of approach of the time of Usertesen, and on the south side was discovered another of granite.

Three huge statues of Min, of prehistoric work, were found on the south side of the temple. The sculptures on these will be noted hereafter, but the plan indicates the position in which each of them was found. They are numbered 1, 2, and 3. Unfortunately, the exhibition does not contain any drawing of these statues, which have been retained by the authorities in Egypt. The head of one of them, however, is exhibited.

It is but natural to suppose that the occupation of the site by different temples in succession would leave relics of various periods, and this has been the case. The objects found, in reality, are of all ages from those of prehistoric date to fairly late Roman times. They consist not only of pottery, but of monumental inscriptions of interest; statues, sculptured steles, and slabs, depicting scenes of temple worship; with a fairly good assemblage of the smaller articles, such as beads and other personal ornaments, generally found on Egyptian sites, so greatly prized by the explorer. Of architectural features there are comparatively few in the exhibition. What these are will be noted later. But the excavations laid bare what must have been originally a charming little chapel, the walls of which were covered with figure subjects and patterns in low relief, the site of which is noted on the plan. It may be well to state that of the objects found, the most important have been retained by the Egyptian authorities for the Boulak Museum. Of these the principal are a fine group of three sitting figures, representing Ramessu II. between Isis and Nebhat. It is of red granite, 6 feet by 5 feet wide, and was found on the temple steps. Two scenes of Usertesen I. offering to goddesses, a long inscription of Antef V., a large granite stele of Ramessu III., etc., have also been retained, as well as the three statues of Min.

The objects found of prehistoric date, now visible, naturally claim our first attention. We shall see, by examining them, to what extent Dr. Petrie's primary object in undertaking the excavations has been rewarded. While they do not possess much to arrest attention at first sight, they are fraught with interest to the earnest inquirer. Here, in modern London, are what appear to be the earliest works that have yet been found in Egypt. One of these is the head of one of three colossal statues of Min. It stands at present under the portico of the University. It has no face, except a few indentations, which lead to the supposition that a wooden mask may have been fitted on to the face. The rest of the figure, and the other two, are kept back at Boulak. They show no sign whatever of chiseling, and their style is so archaic as to warrant the belief that they were worked with flint implements and afterward smoothed to a fair face. Next is a bird of the same early work, found in the temple area, and also a lion, similar to two larger ones now at Boulak, all found in the temple. The large lions were found lying on the lowest bed of clay met with, far below the stairs of the Ptolemaic period, showing conclusively that all these rude sculptures could not be of any later period, but that they must have been old and useless material. All the later objects show traces of the mode of working, but there are none on these. On one of the glass cases upstairs are casts—unfortunately not the originals—of some outlined patterns of unusual interest. They are from the primitive statues already referred to. On one the elephant and the ostrich are dimly outlined in faint lines. These animals do not appear in any historical carvings. There are also indicated shells of the pterocera, and saw fish, which belong to the Red Sea, "and the elephant points to a southern district."

Dr. Petrie has, in his little printed notice of these figures, some interesting remarks which may be well transcribed. He says, in conclusion of his description: "Hence the whole evidence, internal and external, points to these colossi, and the carvings on them, being long anterior to the rise of historical monuments. The close connection of these with the Red Sea points to a time when the race was more in contact with their old home in Punt than with the newer home on the Nile. This suggests that these sculptures may well be even before the Memphite government of Menes, or even possibly before the Thinite dynasty, which preceded that. If the foregoing evidence holds good, these figures are as likely to be before 5000 B. C. as after that date." Thus surely and steadily—it may be that not in every case with exact accuracy—is the evidence of the extreme antiquity of man's appearance in the world accumulating.

Next in order of time are the sculptures of Antef V., who built a temple here. They consist of the thin slabs of limestone already referred to. Some of them have figures in relief, although the period is thus early, but others are incised in the more usual way. They have evidently formed the casings to walls of sun-dried brick, similar to the manner in which similar material was faced at Nineveh. The position where they were found is shown on the plan. The sculptures are very fresh, and many of the slabs can be united.

Next in order of date are sculptures of Amenemhat I. and Usertesen I., who rebuilt the temple. The granite jamb of the doorway has been discovered and it is on view. It is carved in slight intaglio with his names and titles. There is also a fine head of Osiris of this period.

These are followed in period of time by objects of the age of Tahutmes III., who again rebuilt the temple, followed by others of the Ramessides and of the Ptolemies, and these again by the later works of Roman date.

Some of the inscriptions found are of much interest, not only on account of the clearness of the lettering and the execution, but of the subjects recorded.

One of the most interesting of these in point of date, as well as its subject, is a long record of a royal commission sent to Koptos to depose the prince for treachery and to install a new family in his place. He and his descendants are driven from the place and their property confiscated. It is of the time of Antef V. A squeeze only is shown. There is a portion of a fine tablet, a hymn of praise of Ramessu II., an inscription of a major domo of Queen Arsinoe, who rebuilt the temple, and the dimensions are stated. There are also inscriptions of various later times. One in Greek is by the standard bearer of the Palmyrene archers, Markos Aurelios Belkabos, dedicated to the great god Ierablo; another, also in Greek, recording the visit of the Emperor Quietus to Koptos; another, in Latin, setting forth the dedication of the bridge at Koptos in the time of Domitian.

It will be seen by the inscriptions and the sculptures that the rebuildings of the temple are frequently recorded. In addition, there is yet another setting forth that King Rahotep, of whom no monuments were previously known, rebuilt part of it. The ground plan indicates many of these rebuildings, and it would be a curious and not at all an impossible study to identify the various periods of the work with fair exactness. But although the architectural features remaining are so few, the curious evidences of certain foundation deposits are very noteworthy. Dr. Petrie has already found similar ones elsewhere, and has established the fact of their existence in all buildings of importance.

Here the positions where they were found is marked on the plan. They were found in pits dug beneath the walls, and many articles of pottery were placed in each. As many as about two hundred were recovered from the largest pit. There were also a few alabaster vases. These were inscribed for Tahutmes III., beloved of Min, of Koptos. There were also models of corn grinders, made of sandstone and inscribed in blue. In another pit ribbed beads were found; also bronze models of tools—chisels, knives and axes. The angles of the temple of Ptolemaic times also had their foundation deposits, consisting of specimens of pitch, alabaster, basalt, sandstone, copper and lead ores, and model mud bricks, plaques of red and other glass, bricks of lead and copper, a hollow silver case made on wood, and lastly, limestone blocks of small size, gilded.

The architectural details consist of a curious capital with twisted lobes, and a volute, said to be of Roman date, but possibly older, which has been painted in bright colors, red and yellow on a blue ground; a curious gargoyle or spout from a cornice of late date; several interesting examples of pierced limestone slabs to cover over the openings of windows, in much the same way as wood lattice work is now used in Egypt; but the patterns are either simple slits placed side by side, or mere diagonal diamond work; one slab is, however, pierced to form a cross-like pattern, which an examination proves to be the Tau, the emblem of eternity.

The sculptured slabs exhibit many peculiarities of Egyptian work, one of the most interesting being that which represents Usertesen dancing before Min. He holds the hap and oar, and the figures, which are drawn with great precision, are executed in the usual style of Egyptian sunk work, with admirable care. Since this work may very safely be assigned to a period so remote as 2600 years B. C., it is worthy of careful study as showing the condition of the arts at this remote period. It was found covered with stucco and used as old material in one of the later foundations. But a still more delicate piece of work, now placed close beside the above, is a part of a temple sculpture of Amenemhat I. It is in delicate low relief of the beginning of the twelfth dynasty. This, too, was found buried in fragments beneath later work.

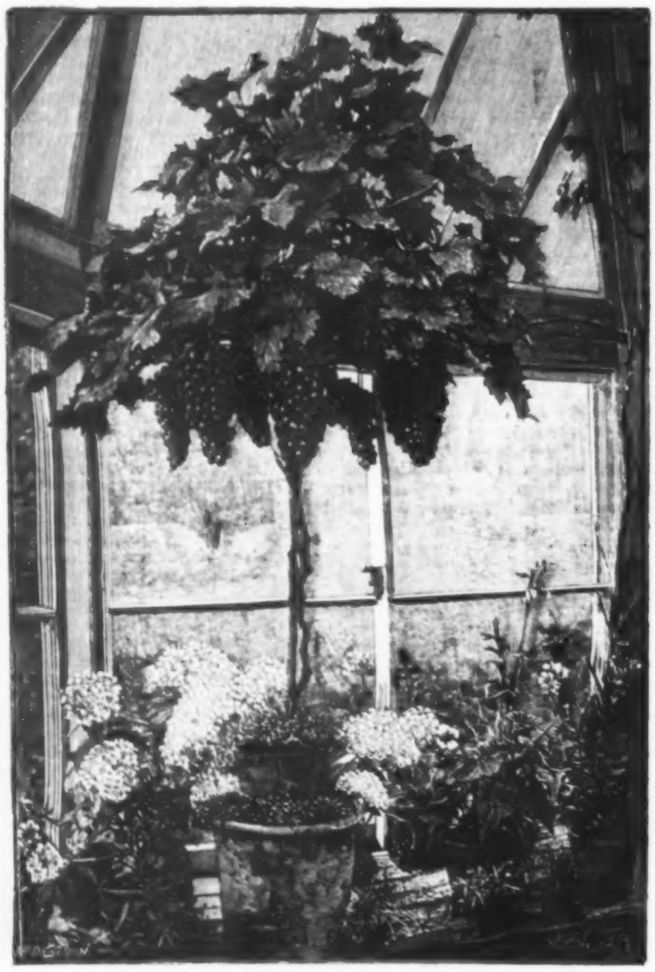
Under the portico of the university is a large tablet

of the architect of the Rameseum, which represents Ramessu II. offering incense before the bark of Isis of Koptos, borne upon the priests' shoulders. One of the finest of the later works is a granite head of a Roman emperor called Caracalla, and probably correctly so.

There is a large collection of pottery objects, for the most part of well-known and familiar types, of which a great many examples are from the curious Foundation deposits. There are many examples of Roman date, showing some instances of similarity with finds of the same age in Europe, with many interesting differences. But the most noteworthy objects are a few examples of very different nature to anything hitherto found in Egypt, about which Dr. Petrie has much to say. They were found in the center of the oldest temple, and are formed by hand, of very coarse Nile mud, faced before baking with a polish of red hematite. Elsewhere are exhibited a large number of flint knives and flakes found in the town, lying upon the stratum of clay before referred to, and buried beneath 20 feet of accumulated earth. In addition, there are ancient models of sacred tanks, altars, corn grinders and many other objects which hardly can be done justice to in a brief article.—The Builder.

POT VINE.

OUR illustration shows a plant of Foster's Seedling, three years old from the eye, and bearing eight large bunches. It was grown by Mr. Higgs, The Gardens, Fetcham Park, Leatherhead, and is a good illustration of successful culture and of decorative effect.—The Gardeners' Chronicle.



A POT VINE.

POISONOUS FODDER PLANTS.

By JOHN R. JACKSON, Kew.

THE question of poisonous cattle foods is one that has frequently cropped up in isolated cases at various times, where, in some instances, the cause of death or sickness has been attributed, or even proved to be due, to certain plants upon which the animals have been fed, either accidentally or when given with ordinary food.

An action was tried recently at the Bristol Assizes, before Mr. Justice Lawrance, in which the Bristol Tramways Company sued a large firm who had contracted to supply a quantity of Indian peas. A certain proportion of these peas, it was stated in evidence, were given to the company's horses daily, crushed and mixed with other foods—as hay, straw, bran, barley, oats, and maize—to the extent of 2 lb. of peas in every 61 lb. of the mixture. The result was that 12 horses died and 127 were down with severe sickness. It was sought to prove that the cause of all the mischief was the so called Indian peas, which were identified as those of Lathyrus sativus. It was not denied by the contractors that the peas were Lathyrus sativus; so the question at issue was the poisonous nature of the seed, and as to what extent it might safely be used. The decision of the judge, after taking time for consideration, was in favor of the plaintiffs.

In this case it was stated by various witnesses that on the road, during the running of the cars, many of the horses fell instantaneously as if shot, many of them stumbled and reeled before falling, and the same thing happened in their stalls. One of the animals expired quite suddenly, and in all those that died the appearance was that of suffocation. Similar symptoms occurred in an outbreak in Liverpool in 1885, and in Glasgow in 1886. The defendants contended that the food had not been given with proper precaution.

In Watts' "Dictionary of the Economic Products of India" considerable amount of attention has been given to the poisonous properties of this particular kind of pulse (Lathyrus sativus). A recent analysis by Artier has revealed the presence in the seed of a volatile liquid alkaloid, probably produced by some proteid ferment, which exhibits the toxic effects of the seeds, and the action of which is destroyed by heat. The evil effects of the habitual consumption of the seeds has long been known, and though the subject is one that has been much discussed, there appears to be no doubt that continued use of this article of diet has a tendency to produce paralysis. In one district of Bengal alone, according to Irving, nearly 4 per cent. of the population suffered from its toxic effects in 1860. That observer went into the subject very carefully and found that if used occasionally, and in small quantity, the results were constipation, colic, or some other form of indigestion, and if freely employed, and especially without admixture with other sorts of food, he found palsy to be a frequent sequel. Dr. Irving's results further showed that ill effects were more apt to occur in the rainy season, and that the great majority of sufferers were males.

A case is stated in which a native woman in Upper Sind had been suffering from paralysis of the lower extremities, and when the case was inquired into by the doctor he was told that the patient, being very poor, had been feeding on kasari, or Lathyrus sativus, for about five months, and in this connection it is said that, though the natives know the seed to be poisonous, they eat it because it is cheap, thinking that they can stop in time to save themselves from serious consequences. This condition has been described by the name of lathyrismus, and has formed the subject of many careful investigations, by which it has been proved that the chief effect on the human system is upon the muscles of the lower extremities, especially on those below the knee. In horses paralysis of the hinder extremities also takes place, but an affection of the larynx, resulting in asphyxia and death, has also been observed—a complication which has not been recorded in man.

Until lately the cause of the injurious action of the pulse was variously conjectured. Some writers held that the noxious properties were due to the large percentage of albuminous matter in the seed. The recent isolation of an alkaloid which possesses the toxic characters of the seed seems, however, to settle the point. An important fact is that the alkaloid is volatile. It may not be present in properly cooked preparations of the seed, such as thin pressed cakes made at a high temperature; but cakes made at low temperatures, or imperfectly cooked, in all probability, retain sufficient of the principle to produce poisonous effects if eaten during a prolonged period. Should it be found possible, by simple increase of heat and greater care in cooking, to render this avowedly noxious food grain a wholesome and nutritious article of food, one of the cheapest and most easily obtainable pulses of India might become much more widely utilized.

In Smith's "Veterinary Hygiene" the danger arising from the use of this food is alluded to. The seed, it is there said, is brought to this country as ballast, and its action on horses is to produce the most intense dyspnœa and roaring when put to work; the appetite is not affected, and when in the stable the animal appears in perfect health. Several fatal cases are reported.

So far back as 1829, the serious effects of this plant attracted some attention in Oudh, chiefly among the native population, but also among horses and cattle, so that it was made the subject of a special report by Colonel Sleeman, from which it seemed that, owing to the failure of wheat, and other spring crops, the lathyrus or kasari which grew among the grain flourished in great luxuriance, and a large crop of it was harvested from the blighted wheat fields. This was consumed by the people during that and the following years, and the stalks and leaves were given to the cattle. In 1833, the bad effects of this food began to manifest themselves, and the younger part of the population, from the age of 30 years downward, were deprived of the use of their limbs, below the waist, by paralytic strokes. Many lost the use of their limbs entirely, and were unable to move. No person once attacked were known to recover the use of the affected limbs. The attack often came on suddenly, even while the person was asleep, and without any warning symptoms whatever. From these statements it would seem that the poison is not only contained in the seed, but that it is also present in the stalks and leaves upon which the horses and cattle were fed, though the effect was greater upon those who had eaten the seed. So far as we are aware, no recent case has been observed of the effects of the fresh or dried plant.

The effects upon horses, described in the foregoing notes, corresponded with those which, according to the evidence given on behalf of the plaintiffs at the recent trial at Bristol, were observed in some of the horses belonging to the plaintiff company.

Referring to the effects of the peas on other animals, Don says, in his "Dichlamydeous Plants," that "swine fattened with this meal lose the use of their limbs, but grow very fat lying on the ground; a horse fed some months on the dried herb was said to have his legs perfectly rigid; kine are reported to grow lean on it, but sheep not to be affected. Pigeons, especially young ones, lose the power of walking by feeding on the seeds; poultry will not readily touch it, but geese eat it without any apparent damage. In some parts of Switzerland, cattle feed on the herb without any apparent harm."

Don further says, on the authority of Duvernoy Fabbroni, of Florence, that the government there had cautioned the peasants against the use of the plant in 1786, swine having lost the use of their limbs, and become pitiable monsters by being fed on this pulse exclusively; the peasants, however, eat it boiled, or mixed with wheat flour in the quantity of one-fourth, without harm. The poisonous property of the seed appears to have been well known so far back as 1671, in which year its use was forbidden by an edict of George, Duke of Wurtemburg, it having previously produced disastrous effects.

The judgment in the Bristol Tramways case may stop the sale of this poisonous seed, and should lead to a more careful examination of its chemical properties, as well as to greater care in the adoption of new fodder plants. It cannot be too well known that many leguminous seeds contain a powerful poison, and before their general use as food, for either human beings or cattle, their properties should be properly tested. The application of heat in the process of cooking often dispels many of the volatile poisons, and where it can be applied it is always a safeguard.

It is noteworthy that poisonous fodder plants are largely the produce of the Leguminosæ. The following plants, for instance, are all well known to possess injurious properties when eaten by cattle either alone or with other food:

Sophora secundiflora.—A small tree or tall shrub of Mexico and Texas, forming dense thickets on the borders of streams, generally in low or moist soil. The seeds are rather larger than a haricot bean, of a bright red color. The Indians in the neighborhood of San Antonio use them as an intoxicant. Half a seed is said to produce exhilaration followed by sleep lasting two or three days; while a whole bean is sufficient to kill a man. A similar effect is produced upon cattle. The poisonous principle is due to an alkaloid known as sophorine.

Several species of Gastrolobium are commonly known in Australia as poison bushes, especially G. bilobum, G. calycinum, G. callistachys, G. oxylobioides, G. spinosum, G. trilobum, and G. obovatum. All these plants are dangerous to stock, large numbers of cattle being lost annually in Western Australia through eating the plants. Drummond, writing in Hooker's "Journal of Botany," says: "The finest and strongest animals are the first victims; a difficulty of breathing is perceptible for a few minutes, when they stagger, drop down, and all is over with them."

So far back as 1846 the subject of these poisonous species of Gastrolobium was brought before the Pharmaceutical Society by a Mr. T. R. C. Walter. A report of his paper appears in the Pharmaceutical Journal for December 9, 1846, p. 311. Mr. Walter stated that it was usual for the natives to burn the pastures every two years. The shrub, however, shoots up the next season, and is then very injurious to stock, its young and tender shoots being probably more tempting and less easily distinguished than the full-grown plant. The blossoms also are frequently eaten by animals, and are perhaps the most poisonous part, for the greatest number of sheep are lost during the period of inflorescence. The wild pigeons greedily eat the fallen seeds and fatten on them. If the crops of these pigeons be eaten by dogs they die, yet the pigeons themselves when dressed are good food and are eaten in large numbers by the settler.

Soon after a sheep has eaten of the plant it assumes a wild appearance, holds its head high up, stares about it, then runs round in a circle, and drops down dead, foaming at the mouth. Horned cattle after eating it have a dull appearance, with a languid eye; they appear to be in much pain, and lie down and die.

Gastrolobium grandiflorum, a species found in Queensland and Northern Australia, is known as the desert poison bush, and is said to have been the cause of poisoning large numbers of cattle and

sheep on the Cape River and at the sources of the Burdekin and Flinders Rivers in 1863-64.

Gompholobium uncinatum, also a leguminous plant, nearly allied to the Gastrolobiums, is a small shrub of New South Wales, and is said to be very injurious to sheep.

Tephrosia purpurea and T. rosea, leguminous plants of South Australia, New South Wales, and Northern Australia, are said to be very deleterious to stock and to have been the cause of mischief on the Flinders River, Queensland. Several species of Swainsonia have an evil reputation in this respect in Australia. The active principle has not been isolated, as it seems to exist only during certain stages of the growth of the plant, and this before the flowering period, for on the drying of the plant it is decomposed. The "Darling Pea" or "Indigo Plant" of Australia, Swainsonia galegifolia, is one of the most dreaded plants by stock owners. Its effect on sheep is to cause them to wander about listlessly, separating themselves from others of the flock, and they are known to the shepherds as "pea eaters" or "indigo eaters." When a sheep once takes to eating this plant, it seldom or never fattens. Mr. Maiden, in his notes on Australian forage plants, gives an account of its effects on horses. Some horses had been hobbled for the night at a place where much of this plant was growing. In the morning they were exceptionally difficult to catch, and it was observed how strange they appeared. Their eyes were staring, and they were prancing against trees and stumps. The second day two out of nine died, and five others had to be left at the camp. When driven they would suddenly stop, turn round and round, and keep throwing up their heads as if they had been hit under the jaw; they would then fall, lie down for a while, rise, and repeat the agonizing performance.

Similar effects are caused by eating the herbage of Swainsonia Greyana, which is said to cause madness. Animals affected by it may refuse to cross even a small twig lying in their path, apparently imagining it to be a great log, or attempt to climb trees and exhibit similar eccentricities. It would seem that the poison present in all these leguminous plants is of an allied nature, but in none does it appear to have been thoroughly examined.

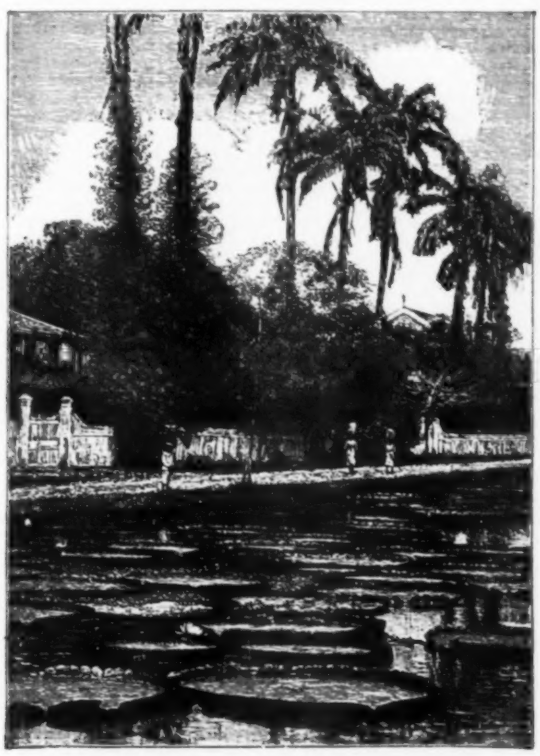
Among plants belonging to other natural orders the following may be enumerated: (1) Trachymene australis, an umbelliferous plant of Australia, known as the wild parsnip. The action of this plant is said to be so powerful that no remedial measures are of any avail, and the only way to rid pastures of it is by pulling it up by the roots and burning it. (2) Sarcostemma australe, the caustic vine of Queensland, a plant belonging to the Asclepiadeæ, has caused the death of a number of fat cattle and sheep that had fed upon it. (3) Eremophila maculata, known in some parts of Queensland as the native fuchsia, belongs to the natural order Myoporineæ, and is by some stated to be very poisonous, while others consider it a good fodder. It appears to be not dangerous to stock when once they get accustomed to it; but to others its effects are deadly. It is said to be more powerful after rain, and most dangerous when in fruit. (4) Euphorbia Drummondii, the caustic creeper or milk plant of Queensland. From the character of the order to which this plant belongs—namely, the Euphorbiaceæ—one would naturally expect to find poisonous properties. It has been stated that when eaten by sheep in the early morning, before the heat of the sun has dried it up, it is almost certain to be fatal. Its effects are thus described: The head swells to an enormous extent, becoming so heavy that the animal cannot support it, and therefore drags it along the ground, the ears get much swollen and suppurate. (5) Stypandra glauca. A liliaceous plant, common in the neighborhood of Sydney, the Blue Mountains, and other parts of New South Wales. The plant, which is known as the Candyup poison, is said to cause blindness in animals that feed upon it, so that they run into any sort of object they meet. It does not seem, however, to have very fatal effects. In Western Australia it is reported to be the frequent cause of what is known as "blind disease."

The few plants here enumerated are given as illustrations of poisonous fodder plants already known. There are many others in different countries that have from time to time attracted some attention in this respect. The subject is one of considerable importance to owners of stock, and might well be taken up and thoroughly worked out, both as to the nature of the poisons themselves and the best remedies for preventing or diminishing fatal consequences in future.

THE GREAT WATER LILY.

(VICTORIA REGIA.)

THIS is one of the largest and most interesting of all tropical aquatics, although its indoor cultivation is almost necessarily limited to perhaps less than half a dozen gardens in this country. Its culture with us is expensive, requiring a large house and tank thirty feet or more in diameter, and a costly heating apparatus, to say nothing of minor details, all more or less troublesome and costly. Although not naturally an annual, it flowers much better when so treated in this country, and seedlings are raised every spring. These are planted out in April, on a mound of richly manured compost, the temperature of the surrounding water being kept as near 80° as possible by means of hot water pipes, which are conducted round the bottom of the tank. In order to keep the water fresh and sweet, some system must be adopted to secure circulation, and this may be obtained by having water constantly flowing into the tank on one side with an outlet at the other. Some cultivators employ a small overshot wheel, which is turned by the inflowing water, and at the same time keeps the whole body of the water in constant motion. This appliance is, however, not absolutely necessary, as the inlet and outlet pipes, with a constant supply of fresh water, is all that is requisite to insure success. There are, however, many situations out of doors in which this plant will not only make a luxuriant growth, but produce flowers during the summer months. It has already flowered at several places in England, where tanks have been formed to receive the condensed steam from the engines of waterworks or manufactories, and in favorable situations like these it deserves a fair trial. The main elements of success consist in having a strong, healthy, well established plant ready for planting out in the latter end of May or beginning of June, and, in order to prevent the growth being checked, it would be advisable to have the young specimen planted in a coarse basket of wickerwork, using a rich compost of sandy loam and well rotted hotbed manure. This basket and its contents would not take up much room in a shallow tub or tank in the plant stove, and when the mild weather arrived the plant could be gradually hardened off, and the basket and its contents might then be placed in a suitable position in the open air tank. The plant is a native of Guiana, where it occurs in the Parana River, and South America, being found abundantly in some of the sheltered tributaries of the Orinoco and also in those of the Amazon. In its native habitat the flowers acquire a richer rosy tint than in our hothouses here at home, where it is a rarity to see more than one of its delicately perfumed flowers open at the same time. The leaves of this species are frequently six feet or even more in diameter, and float on the surface of the water, being supported by a beautiful network of hollow veins. The under surface of the great table-like expansion is of a rich purple color, the upper surface being deep green.—W.



VICTORIA REGIA IN THE STREETS OF GEORGETOWN, DEMERARA.

Mr. Fitzherbert, to whom we are indebted for the photograph from which the engraving was prepared, thus describes the Victoria Regia as growing in a Demerara street:

"There are few who have the privilege of such intimate association with the Victoria Regia water lily as the inhabitants of Georgetown, British Guiana, for many of them are unable even to leave their front doors without seeing it staring them in the face. In the outskirts of the town, behind white palisades, the deep verandaed and jalousied houses stand back from the road, among the cabbage palms and flamboyants, rampant bougainvilleas and large-leaved aroids, and, space being apparently of little account when the streets were laid out, in the middle of and parallel with the road, dividing it in two like the six-foot way between two lines of rails, runs a wide canal, shown in the illustration, filled with the huge platters of the lily leaves, with here and there a few large white blossoms, looking, however, ridiculously small by the side of the leaves, some of which are enormous.

"When there is little traffic about, spindle-legged, long-toed jacanas may sometimes be seen disporting themselves on the tray-like leaves, jumping the edges with the skill of a practiced hurdle racer and peering now and again into the white cups of the flowers. To a stranger these glimpses of tropical life are full of interest and pleasure, but in the moist vapor bath of the climate they soon pall on even the most ardent lover of nature."—The Garden.

CALOCHORTUS WEEDII.*

THIS is a yellow-flowered Californian species, lately exhibited before the Royal Horticultural Society by Messrs. Wallace & Co., of Colchester, to whom we are indebted for the opportunity of figuring the plant. The rich yellow self-color affords a contrast to the many-hued flowers of other species. It has also been called C. citrinus. Mr. Baker considers the present plant to be a variety of C. luteus, differing in the circumstance that the petals are not spotted, while their whole surface, not a part only, is covered with long brownish hairs. The flowers are described as "saturate aurantiaca," but as shown the color was pure yellow (flava).—The Gardeners' Chronicle.

CALOCHORTUS WEEDII—FLOWERS YELLOW.

[CONSULAR REPORTS FOR AUGUST.]

PEACH CULTURE IN BELGIUM.

IN ordinary seasons, the Kingdom of Belgium, which is not larger that the State of Maryland, after supplying a population of 500 to the square mile, exports 105,000,000 pounds of fruit. Last year, although not a drop of rain fell from the first of March to the middle of August, the markets were glutted, and the value of the foreign shipments rose to $3,000,000. A very large per cent.—the ratio is not stated in the report from which I quote—was peaches, and peaches of the finest varieties.

It has occurred to me that there are other causes than the nearness of the Gulf Stream and the warm winds from Sahara for the fact that Belgium, lying abreast of Labrador, though of equal temperature with our interior States, should so far surpass these in the production of peaches. With similar geological formations, soils and climates, a year's residence in Liege has presented just such meteorological phenomena as I have witnessed in Indianapolis, Louisville, St. Louis and Leavenworth; there can be no natural reason why the one should not produce, and with equal certainty, everything grown in the other.

Thirty years ago, Kentucky was unsurpassed in the production of this fruit. Neither in New York, when Delaware and New Jersey had shipped their harvests thither, nor in California, nor in any of the capitals of Europe have I seen finer peaches than were once grown in the blue grass country. And this was true, no doubt, of the entire section I have indicated. But now all is changed; where orchards formerly flourished, a tree is hardly to be seen; where the fruit was once large, ruddy, and delicious, only a few pale and insipid seedlings are to be found. The farmers say that the climate has changed; that in denuding the lands of their forests they cleared the way for the winds; that constant cultivation and artificial fertilizing have changed

* C. Weedii, Wood, Proc. Acad. Phil., 1868, p. 169; C. luteus, Douglas, var. Weedii, Baker, in Jour. Linn. Soc., vol. xiv., p. 300.

the character of the soil, and this conclusion is fully confirmed by the experience of the Belgians.

As long ago as the invasion of Cæsar, this country was famous for its fruit, but the extension of systematic agriculture in the middle ages denuded the land of its woods, and crops became capricious.

When a people has increased to 500 to the square mile, a conservative government can leave nothing to chance. Since the revolution of 1830, therefore, the State has looked after its every industrial enterprise with paternal solicitude. Agriculture—food producing lying at the base of them all—has, perhaps, been the most zealously fostered. Every conceivable device has been tried to make two blades of grass grow where only one grew before.

In fine soil, and in situations protected from the north and northeast winds, peach trees grown from the seed have, in all the past, occasionally borne fruit, but the Kingdom of Belgium is to-day the kingdom of uses, and everything must do its duty or perish. To ascertain the best stock upon which to bud, a long series of experiments were tried and tried again upon all the varieties of prune, the apricot, sweet and bitter almonds, every tree indeed of a kindred nature, till the conclusion was reached that the best stem for grafting is the red plum, found in many places in the United States. This hardy plant, whose roots spread wide and strike deep, imparts much of its own vitality to its foster scions. Grafting or budding is done out of doors, so as not to soften the young tree by accustoming it to unnatural conditions.

The next question they considered was that of soil. In sandy and dry earth, it was found that neither the plant nor the peach flourished, the one being spindling, the other small, while in rich and moist alluvial, the tree prospered at the expense of the fruit. A calcareous soil, neither wet nor dry—and this nature has partially supplied to our Middle States—is preferred by the peach, the young trees requiring a great deal of lime. As it is impossible to tell, without chemical analysis, the exact amount of this element contained in any given quantity of earth, its application must be more or less experimental. However, the rule here is to first thoroughly fertilize the soil with guano or chicken ordure, and then, after planting the tree, add a peck of lime to every cubic yard of earth, placing it near the surface. As it is necessary to loosen the earth for at least 6 feet square and 3 feet deep, this quantity, a bushel to the tree, may seem large, but the authorities are all agreed that more rather than less would be better. The application should be repeated every three years.

Turning from the standard tree, which too often failed to be profitable, they experimented with espaliers (wooden railings), but these were found to be so open and exposed that the young trees fared very little better upon them than in the orchard. They next tried the wall, not as in England, where mural inclosures are built at great expense for the special protection of delicate fruit, but the sunny sides of their houses, and met with such astonishing success that there are few houses to-day in Belgium upon whose southern exposures trees are not trained. No chateau is too grand and no cottage too humble to furnish them protection and support. Last summer I saw ripening upon the gable end of a town house, a surface of about 30 feet square, 2,327 peaches, and every one of them larger than a hen's egg. There were four trees, two of them with dwarf stems not more than 12 inches high, and branches 6 feet long and radiating like the ribs of a fan, and two riders (bushes grafted upon tall stocks) whose boughs began to spread where the others terminated. The projecting limbs had, of course, been removed and all their vitality forced into the lateral branches. Any Californian can beat this, perhaps, but trees out there flourish in the open, and are permitted to retain all their limbs. I take it for granted that everybody knows the limbs of wall trees are comparatively few in number, and are held in their positions by strips of strong canvas.

Now, there are many thousand acres of southern wall of almost tropical heat in our Middle States, which, if utilized in this way, would furnish a certain and abundant supply of peaches to every family within their limits. Why should the ivy, the wisteria and the Virginia creeper be brought from afar to break the force of the sun and beautify homes when the peach, which is at hand, surpasses them all in foliage and in flowers, and closes the year with a harvest of fruit? Nothing grown on the earth yields a larger dividend of pleasure or of profit. The labor of planting, training and protecting is practically nothing, as it could all be done on rainy days and at odd hours, when idleness in the country is apt to be oppressive.

At the time of flowering it is always necessary to shield the buds from the action of frost, and this is done by various methods, the best of which experience has shown to be the placing among the upper boughs of the trees of branches cut from other green trees. This plan has been attended by good results, though it should be employed with great caution, as too much shade is apt to stifle the germs by excluding the rays of the sun. Another method, until recently very much in vogue and always effective, is the employment of mosquito netting or other cheap material with meshes large enough to admit the free passage of light and air. The old custom of using closely woven cloth, like table or bed linen, at night and removing it in the morning, is said to be more dangerous than the frost itself, as the trees at this season cannot be deprived of air without serious injury; besides, this artificial heat at night, succeeded by the warmth of the sun, hastens their blowing when the object is to delay it as long as possible. Shading at noon is sometimes as essential as covering at night. The poor succeed very well in protecting their fruit by placing a number of horizontal poles about 18 inches apart, and from 4 to 6 inches from the trees, and covering them with light wisps of straw; but this device is unsightly and makes a deal of litter.

In good situations, penthouses (sheds of wood, thatch or straw projecting 18 or 20 inches from the wall and covering the tops of the trees) will sometimes suffice to protect the fruit. In any case, they are extremely useful in checking the flow of the sap. Since 1876, the following addition to this method has made assurance doubly sure: A fringe made of unthrashed rye straw by tying the cut ends of the stalks together with twine or garden cord, six or eight in a loop, with spaces of about 3 inches between the wisps, is attached to a neat pole and suspended under the eaves of the penthouse and in front of the trees. The texture being open, it does not prevent the light and air from reaching the buds.

One might be tempted to believe that this method would hurry the blooms, but it has, in fact, the very opposite effect. The brilliant surface of the straw, by reflecting the sun's rays, keeps the temperature beneath lower than that on the outside. These shields are usually placed in position about the 1st of March, and are not removed, except in cloudy weather, until all danger from frost has passed. Water from the roof is never permitted to fall upon a tree. When not carried off by gutters, the penthouse is always employed. NICHOLAS SMITH, Consul.

Liege, April 10, 1894.

BLACK SAND.

AT various points along the Pacific coast from Gray's Harbor, Washington, on the north, to Point New Year, thirty miles below San Francisco, on the south, there are found heavy deposits of a heavy black sand, of about the fineness of ordinary beach sand, which contain more or less of finely divided but rather pure gold particles. This is called black sand, from its color, which is usually black, and sometimes iron sand, from the fact that chemically it is mainly iron. The deposits are of two kinds—the old beach sands, meaning those which lie considerably above the present water level, and the new or late sands, which form part of the present beaches, and, like the other beach sands, are moved back and forth by the waves.

The gold-bearing sands along the present beaches are usually black in color and are composed mostly of particles of magnetic iron; that is to say, of the magnetic oxide of iron, called magnetite. In chemical constitution the substance is considered to be a mixture of the protoxide and sesquioxide of iron, having seventy-two parts metallic iron to twenty-eight of oxygen. It is hard, sometimes scratching glass; its specific gravity is about five. It is strongly magnetic and is infusible. It is found in nature disseminated through granite, gneiss, mica slate, syenite, hornblende slate, chlorite slate and limestone, and at other times forms extensive beds of ore suitable for making the finest qualities of iron and steel. It is the same as loadstone or native magnet, excepting that the latter possesses polarity. It is maintained by some that the magnetic ore in the shape of black sand is even better adapted for steel making than that which occurs in beds. But why this should be so is not explained. With the iron, which usually amounts to half or three-fourths of the whole bulk, there are other substances which may be regarded as impurities. They are first, and most useless and deleterious, titanic iron, called ilmenite, a substance possessing the same hardness, color and specific gravity as magnetite, but of no use in the arts, although it is rich in oxide of iron, and is prejudicial in smelting. Rounded quartz sand forms a varying proportion of the beds, sometimes nearly the whole and sometimes being entirely absent. The gem called zircon, a silicate of zirconium, also exists in the beach sands, and is not rare, though too small to be noticed except mineralogically. These, with other and rarer substances, make up the black sands, with the exception of the contained gold, which is supposed to be always free or unincumbered.

During the time that experimenters have been dealing with the problem, a large number of people have been making a living and some few getting rich by working the sands in the simplest and cheapest possible way; namely, by sluicing or rocking. It was in 1852 that the first work of the sort was done; it commenced that year on the California coast at Gold Bluff, near Crescent City, and in Oregon at the beaches at the mouth of the Rogue and Coquille rivers. Over a thousand miners were engaged in the industry at various points along the Pacific shore in the following years, the most being congregated near the points named, where the sand was richest. Work has been kept up at those localities, and intermittently at many others. No close estimates of the number of miners engaged therein have ever been made, nor of their earnings; but estimates for particular years have often been published. Probably the average number of miners employed steadily at this work would not vary much from 500, taking the years together. There has been a gradual decrease from 1856, when the number was greatest. In that year the coast of Curry and Coos counties was the scene of very active operations, and the former county contained then and for several subsequent years more people than it has at present. Large camps were built at various points, and some of them remain populated at this day. Randolph, at the mouth of the Coquille, the center of the "high" or old beach mining industry, was the principal camp. Still, the resources of gold are not by any means exhausted, nor are they exhaustible, if judged by their present appearances. There is hardly any diminution of riches noticed in the moving sands of the lower beaches, while the high deposits have hardly been touched. Explorations continually reveal more of the latter, and the ocean is continually providing more of the former.

The product of the Pioneer mine in Coos county, Or., was $18,600 in one year.

The most important "old beach" deposits occur about the mouth of the Coquille river, Coos county, where there are beds of many feet in thickness, overlaid usually with barren sand and other debris to a greater or less extent, the principal bed being buried under such a thickness that it would require extensive mining operations to obtain the gold which is known to be disseminated therein. For working a deposit of this kind, a system of drift mining is recommended, wherein the overlying mass of gravel is supported temporarily by timbering, while the auriferous materials are sluiced out and the gold recovered. An open cut might be run to the sea, in which cut a long line of sluices with riffles should be stationed. Working a block of gravel here several feet in depth, although lying under from twenty to forty feet of worthless material, might be expeditiously and safely performed this way. These deposits have a sameness of description; they lie 30, 60, 100 and even 300 feet above the present beach, and are referable to various periods of elevation of the shore line, probably not, geographically, very ancient in any case.

In Tillamook, Or., a new process has been introduced by which it is claimed that fully ninety per cent. of the gold can be saved. The body of black sand is almost unlimited, as it is found nearly everywhere on the ancient beach which extends inland along the Coquille river about two miles and has been traced north and south to a considerable distance. A complete successful process would be hailed with joy all along the coast.

Since the above was in type, the following was noticed in the current number of a Del Norte Co., Cal., paper, published close to a large deposit of this sand, and is here appended as illustrative of hundreds of similar items that have been published in this paper in the last thirty-four years, exemplifying the fact that the industry is a permanently paying one, and that there has been little change in the successful methods of securing the gold:

The black sand mine of E. Yates, a couple of miles below Crescent City, is running in full blast, and indications are that it is a bonanza. The machine used for saving the fine particles of gold is similar to the "Old Tom," in use for many years in mining along the beaches. In this machine twenty-five square feet of corrugated copper plates are used, the usual mercury being put on. After the sand that contains the gold passes over the plates, it passes over a blanket. Should the plates fail to catch all the gold, the blanket does it. Mr. Yates believes that almost every particle of gold is saved. In a run of fifty hours about $100 was saved. The indications are that the other portions of the property are richer than this, as it is among the driftwood that he is now getting his sand.—Mining and Scientific Press.

THE LIBYAN DESERT.

THE following is an abstract of the paper read before the British Association by Mr. Herbert Weld-Blundell, giving an account of his journey to the oases of the Libyan desert:

He started from Siout to the oasis of Khargeh. Here he took a set of photographs of the Temple of Hib, founded by Darius I. of Persia, 525-485 B. C., and restored by Darius II. and III. He pointed out the similarity of language of piety and devotion expressed to the gods of Egypt to that employed by that monarch in his cuneiform inscriptions at Persepolis and Behistun. Mr. Weld-Blundell next visited the lately rediscovered oasis of Um-ed-Abadeb, literally the Mother of Thuds, so called from the noise of a stone dropping down the deep well shaft in the locality. The name has now been changed to Abbas, in compliment to the Khedive. Here there was an extensive tract of ruins dating from the Roman occupation, the central point being a large square fortress fitted inside with a complete system of small vaulted cells and surrounded by groups of ruined buildings, all showing the same series of round-arched vaults. They showed no definite plan of arrangement, and may have been simply the various buildings in which prisoners were confined.

Mention of penal settlements was met with among Egyptian monuments dating as early as the XIXth Dynasty, and alluded to by various Christian writers. Within the precincts of the prison grounds was a half-domed temple, with Christian inscriptions rudely scratched in Greek letters. Apparently through the silting up of the wells, which were very elaborately vaulted and tubed underground, or in consequence of earth movements, the water supply failed, and the place was entirely abandoned from Roman days till about 20 years ago, when a runaway camel was followed and traced to the spot. Owing to want of enterprise and necessary implements the well had never been cleaned out, and the place, though possessed of an extraordinarily fertile soil, was entirely uninhabited. The next journey was to Dakhleh. This was an oasis separated from Khargeh by a peninsula of high land, which formed the Libyan desert plateau, and in which the oases were depressions containing the now shrunken tracts of vegetation that rose like green islands from a petrified ocean.

Muth was a village of some importance, and was built on a mound of bright golden ocher, the streets and people being covered with a bright yellow dust, a relief to the usual dull mud color of an ordinary Egyptian village. Gasr, a town ten miles to the north, was principally interesting from the vicinity of an Egyptian temple of the second century of our era. The walls inside and the chambers were thickly inscribed with hieroglyphs, but the work was late and inferior in artistic quality. The journey thence was continued to the northwest oasis of Farafrah, a small and continually dwindling community of about 300 souls, who were very poor, owing to their want of enterprise and isolation. Four days of continuous traveling brought the party to Bahariah, known to the ancient writers as Oasis Parva. This town was prettily situated in groves of luxuriantly growing palm trees. Water was in abundant supply from over 100 wells. Some idea might be given of the apathy and poverty of the settlement by the fact that, although water could be obtained at a depth of 140 ft., which would immediately transform the apparently forbidding desert into a fertile oasis wherever it was directed by irrigation channels, no appliance whatever existed in the whole settlement, numbering in all nearly 9 000 souls, for boring or even keeping well shafts open from the continual encroachments of the sand. From here he struck by a straight road back to the Nile. Returning then to Alexandria in order to make a fresh start for Siwah, the most western oasis, at the very confines of Egyptian territory, he started with a caravan of the tribe of Aulad Ali. This tribe, having made themselves obnoxious to all their neighbors by their depredations and general iniquities, had a delicacy about going anywhere near their frontier, so that it was absolutely necessary to start from a point within the limits of their country, which extended from the Nile Valley to Siwah. The route taken was that along the southern edge of the North Libyan plateau, which rose like a wall from the great alkali tract or marsh that stretched from near the Natron lakes to beyond Siwah and Jerabub, a distance of over 400 miles.

This tract, lying from 140 ft. to 350 ft. below the level of the sea along the route traversed, was covered with

a crust of alkali deposited by the water rising to the surface and covering a saturated and marshy subsoil. The nature of the ground was unpleasantly illustrated by a camel going through the crust like rotten ice and having to be lifted out by ropes. Siwah is described as a sort of ruinous honeycomb of houses piled up on a natural rock in the marshy plain and surrounded by groves of palms, which were here of an exceptionally fine quality, and were almost the only wealth of the population. This numbered about 20,000 souls. The Egyptian government was only feebly supported by five soldiers, and was represented by a mamur or prefect, a cadi or judge of ecclesiastical law and official correspondent.

In a turbulent town of 5,000 armed men it might be considered that the Egyptian authority only existed on sufferance, and it was some credit to the present mamur that, occasionally besieged and shot at, and always treated with scanty respect, he had been able to hold his own and keep his place for 13 years. The Temple of Jupiter Ammon was shown, though not much remained of this, the oldest oracle in the world, to enable archæologists to give much idea of its plan and appearance.

The return to Alexandria was over the back of the Great Libyan plateau and the road followed by Alexander the Great. The whole journey from beginning to end covered a distance of about 1,200 miles. There was considerable sickness among the Arabs. The guide unfortunately died near Siwah, and others were laid up with fever and inflammation of the eyes. He himself was the only European, and none of the Arabs could speak any language but their own.

THE ORIGIN OF WORLDS.

WHEN Laplace invented his celebrated nebular hypothesis to account for the origin of the solar system, he did not know that the satellites of Uranus and Neptune, the outermost planets of the system, revolve in a retrograde direction, or contrary to that pursued by all the planets in their orbits around the sun, and, as was then believed, by all the satellites in their revolutions around the planets. If he had known that fact, it is possible that he would never have put forth his hypothesis, for the retrograde motion of the satellites of Uranus and Neptune, and the probable retrograde rotation of those planets themselves, are fundamentally opposed to the nebular theory as Laplace stated it. Many have believed, indeed, that the theory must fail on account of the anomalous behavior of the satellites of the two exterior planets, and various modifications have been proposed in order to reconcile it with the facts. But none of these modifications has been accepted universally. Quite recently, however, new light has been thrown upon this vexed question, and from an entirely unexpected quarter. Among the remarkable discoveries announced from the Harvard Observatory, established three years ago at Arequipa, in the Peruvian Andes, have been certain surprising anomalies exhibited in both the forms and the motions of the four principal satellites of Jupiter. These satellites, as is well known, were discovered by Galileo 284 years ago, and are so easy of observation that anybody who has sufficient curiosity to point a five-dollar spy glass at Jupiter can see them. They have been carefully studied for more than 200 years, and it was not supposed that any very startling facts remained to be discovered concerning them. But in 1892 Professor William H. Pickering began to announce the results of a series of observations at Arequipa which were received by some with incredulity and by all with surprise. These observations were continued in 1893, and Professor Pickering added from time to time to the statements of discoveries and deductions, until the amount of details which he presented staggered the most incredulous. The fact that the Arequipa observations have not been confirmed at the Lick Observatory has, of course, militated against their general acceptance, but it is suggested that this is only a repetition of the history of Schiaparelli's discovery of the "canals" on Mars. The original discoverer always possesses an immense advantage over those who do not look with his eyes and employ his methods. Moreover, the Arequipa Observatory is elevated nearly twice as high above the sea as the Lick Observatory, being perched more than 8,000 feet above the level of the Pacific Ocean. The atmospheric conditions at Arequipa are, consequently, of the most extraordinary excellence, although it is difficult to believe they can greatly excel those at Mount Hamilton.

Yet, as has been intimated, there is a convincing array of details in Professor Pickering's statements, which renders it difficult to believe that he and his assistants have been misled by any deceptive appearances. Even if some of the Arequipa observations should prove illusive, others are certain to stand, and the general conclusions may not be shaken. Let us see then in what respects they tend to upset our former ideas about the moons of Jupiter, and what their bearing is on the nebular hypothesis. In the first place, instead of being simple round bodies, the Jovian satellites appear at Arequipa of various shapes, presenting at certain times a decidedly ellipsoidal form. This is particularly true of the first or inner satellite, which sometimes appears perfectly round, and at other times is plainly an ellipsoid of considerable eccentricity. By a careful study of the apparent changes in the form of the satellites, combined with their positions in their orbits, Professor Pickering has reached the conclusion that they rotate upon their axes in a very peculiar manner. The first satellite, which is decidedly egg-shaped, turns end over end, and, moreover, it turns or rotates backward exactly contrary to the direction in which it revolves around Jupiter. In this respect, as will be noticed, it accords with the satellites of Uranus and Neptune in violating the general rule of motion which otherwise prevails, as far as is known throughout the solar system, comets being excepted. The other satellites are also egg shaped, though not as eccentric in that regard as the first, but instead of rotating end over end, they turn upon their major axes—in other words, they rotate as an egg would do if compelled to turn on a knitting needle thrust through it from end to end.

In seeking an explanation of these curious facts, Professor Pickering suggests that Jupiter was once surrounded, as Saturn now is, by a system of rings composed of an enormous multitude of meteorites, and revolving around the planet in the same dieection in which it rotates on its axis. Through the action of some force whose origin is not explained, the rings were shattered and the meteorites, still retaining the same orbits, gradually drew together, forming the present satellites. These satellites, owing to the tremendous tidal effects of Jupiter's attraction, have not yet consolidated, but remain in the form of dense swarms of meteorites. Now, if the rings instead of being meteoric in composition, had originally been solid, it is clear that their outer edges as they whirled around Jupiter would have moved faster than their inner edges, as the rim of a wheel moves around faster than the hub. Of course we are speaking not of angular, but of absolute velocity. When such a solid ring was broken and its fragments drew together into a single body, the component parts of that body would retain their original momentum and the outer side of the body, as a whole, would tend to move faster than the inner side. Hence a direct rotation would arise—that is to say, a rotation in the same direction as that in which the body was traveling in its orbit around Jupiter. But the behavior of a ring of meteorites, such as each of Jupiter's satellites is supposed to have actually been formed from, would be quite different. In the first place each meteorite would travel with a velocity inversely proportional to its distance from Jupiter. Consequently, the outer edge of such a ring would move more slowly than the inner edge, just as the more distant planets travel at a less rapid pace around the sun than that made by the nearer ones. When such a ring was broken, and then drawn by the mutual attraction of its fragments into the form of a comparatively compact swarm, the meteorites would, as before, retain their original momentum, but in this case the result would be that the outer side of the swarm would tend to move slower than the inner side, and consequently a backward or retrograde rotation would arise, just contrary to the direction of the swarm's revolution around Jupiter. This, according to the theory we are discussing, must at first have been the manner in which all of Jupiter's satellites rotated. Now the tidal action of Jupiter would draw any such swarm of meteorites into an oblong form, and as soon as the swarm was thus misshapen, Jupiter's attraction, acting upon the protuberant parts, would tend to make the swarm rotate on its axis in the same direction in which it revolved in its orbit. This tendency, counteracting the original retrograde rotation, would produce in the satellite swarm a condition of unstable equilibrium, the ultimate result of which would be that the satellite would invert its poles so as to bring its direction of rotation into accord with that of its revolution. The forces concerned in the polar inversion of a planet or satellite originally rotating in a retrograde direction can be illustrated by means of the gyroscope, which, when its axis is constrained to rotate, always endeavors to bring the plane of its own rotation into parallelism with that of the rotation impressed upon it, and also to make its direction of spin correspond with the direction of its new rotation. In the case of Jupiter's first satellite the inversion has not yet been brought about. It is to be remarked that this satellite is the least dense of all.

The same forces and influences which have acted, and are acting, in Jupiter's satellite system, possess, according to Professor Pickering, equal validity in the solar system at large. In other words, the rings formed around the sun, according to Laplace's hypothesis, were composed of particles which, after the rings were broken, produced, through the survival of their original rates of velocity, a retrograde rotation of the partially condensed planets formed from them, and a similar revolution of the satellites of these planets. There must have been a time, then, when the earth and all the other planets rotated from east to west, and when the sun, to an observer on the earth, would have appeared to rise in the west and set in the east. But slowly the earth's poles were inverted, until the direction of rotation accorded with that of revolution, and the sun rose and set as it does to-day. During the course of this inversion there must have been a period when the axis of the earth lay parallel to the plane of its orbit. At that time the sun, to use Professor Pickering's expression, "spiraled around the earth from pole to pole every six months, the tropics reaching the poles and the polar circles the equator." All the other planets, excepting Uranus and Neptune, have, according to this view, undergone an inversion of their poles, and a consequent change in the direction of their rotation. With Uranus and Neptune the process is uncompleted. Uranus, the nearer of the two, shows a closer approach to the ultimate condition which it must some time attain, for it rotates nearly at right angles to the plane of its orbit; in other words, it is now nearer the position which the earth occupied when the sun appeared to move round it from pole to pole. Neptune, on the other hand, has its axis tipped far over, and the process of polar inversion has made comparatively little progress. But, if the theory is correct, Neptune, too, will in the remote future fall into line and obey the rule of west to east motion which governs in the solar system, and which, although it may be opposed for vast periods of time, cannot forever be successfully resisted. Thus, an objection to Laplace's hypothesis, which he himself would, perhaps, have regarded as fatal, is caused to disappear when certain modifications are introduced in the hypothesis that bring it into accordance with observed facts without destroying its identity as a whole. And thus the study of that beautiful assemblage of satellites which render Jupiter an object of increasing admiration to every possessor of a telescope, and which has been likened to a solar system in miniature, is caused to throw light upon the question of the origin of the entire system of which Jupiter is only a member, though, next to the sun, its greatest member.—New York Sun.

THE WATER HEN.

By HARRY F. WITHERBY.

THE water hen or moor hen (Gallinula chloropus) is very generally distributed throughout the British Isles. It may be numbered among our most familiar birds, but, owing to its shy nature, its habits are difficult to observe.

The word "moor" seems to have once signified a marsh, and the moor hen being an inhabitant of marshy places, thus received its name, but since by "moor" we now understand heathy and more or less dry land, the name water hen seems to be more appropriate.

On almost every lake, pond or stream on the sides of which reeds and rushes grow, there will be found one or more pairs of water hen, and when frost drives them from the lakes and ponds they resort to running streams and tidal rivers; but except on these occasions they remain, summer and winter, in the same locality.

The water hen belongs to the rail family (Rallidæ), the members of which have not webbed feet, though several of them have either partially webbed feet or are provided with an analogous growth to aid them in swimming. The water hen has on both sides of each of its toes a narrow membrane, which expands as the foot strikes the water, thus greatly enlarging the width of the toes and affording the foot a greater resistance against the water.

The feet are exceedingly large and the toes very long for the size of the bird, making it look almost awkward. The usefulness of these overgrown toes, however, is soon apparent when we watch the bird gliding over reeds and rushes, and threading its way in and out through a labyrinth of flags. The bird walks with perfect ease over huge networks of reeds, which have laced themselves together after the growth of years, its large feet preventing it from slipping through the meshes.

The water hen resorts to all sorts of methods to elude its pursuers. Sometimes it will lie motionless, hiding itself among rushes and refusing to fly. I have known them to lie so close that a young retriever brought one in his mouth out of some reeds. At other times the water hen swims along half under water like a water-logged vessel, with just the top of its back and its head and neck showing above the surface, thus often escaping notice. In swimming and diving the water hen is also an expert; it dives down, swims some distance under the water, using both wings and legs, and suddenly comes up again at the most unexpected spots. Sometimes it will only put its head and beak above the surface, and after taking a breath of air disappears again, to rise in the midst of some rushes, among which it is soon lost to view.

The bird swims with a very jerky motion, going from side to side in a restless way, and moving its head backward and forward as it proceeds, every now and then dipping its head into the water in pursuit of some small fish or insect.

A bird so clever in the water is usually clumsy on land, but not so with the water hen. It walks about neatly, and runs very quickly, nodding its head and bobbing its tail, each time displaying its white under feathers. Its adroitness on land enables it to obtain more varied food than if it were confined to the water only, grass, slugs, worms, insects and grains being in this way added to its diet.

Although very shy, the water hen soon becomes tame, and, indeed, semi-domesticated, on a piece of water near the haunts of men. If ducks are kept on the same pond, the water hens will come and feed with them when corn is thrown down, and they may often be found on ponds adjoining a railway, taking no notice of the passing trains.

Its flight is low and straight. When passing over the water it keeps so low that its legs, which hang down during flight, very often trail along the surface, leaving a track of bubbles.

The call note is a loud "crek-rek-rek," seldom uttered in the day, but during the evening the note may be repeatedly heard.

It builds its nest in very varied situations. Usually it is placed among reeds or rushes, but often in the branches of a tree overhanging the water and nearly touching it, and sometimes even in a branch ten or twelve feet up a tree. At other times it may be found on the top of a mass of debris on the bank of a stream. The water hen is a careless builder and seldom attempts to conceal the nest, although it will often cover the eggs on leaving them. The nest is built of flags or rushes, and varies greatly in size. Though generally flat and long, I once found one round and deep, which, strange to say, was composed of leaves and grass. The eggs are six to eight in number, and they are dull white, speckled with reddish brown. Two or even three broods are reared in a season, so that although the water hen may be a careless nest builder, she cannot be said to be an idle mother.

The first eggs are generally laid early in April, and in three weeks the young are hatched. When first hatched they appear as fluffy black balls of down, and immediately take to the water, swimming about and diving with perfect ease. In the evening the old bird may often be seen brooding the young in the nest, with perhaps one or more of her chicks on her back. When they are big enough to fly, however, they accompany their parents to roost in the bushes and trees near the water.

The eggs of this bird can be hatched under a hen, and when the young are so reared they become very tame and may be kept in an aviary or on ornamental water.

The female is slightly larger and a little brighter in color than the male, but otherwise she resembles her mate. The upper parts of the bird are of a glossy olive brown, so dark that at a distance the bird appears to be almost black. The under parts are dark slate gray, shading down to a clouded white, while there are streaks of the same color on the flanks. The under feathers of the tail are white, contrasting with the almost black upper feathers. The iris and bill are red, and the bill is rendered still more striking by a bright yellow tip. The legs, which are of a pale green, have a bright red band just above the so-called knee. It may here be said that what is generally known as the knee of a bird is in reality the tarsal or ankle joint, and not the knee at all; the knee joint being higher and concealed by skin and feathers.

The young birds of the year are lighter in color than the mature birds, and they have green beaks.—Knowledge.

THE paper for the Bank of England notes is always made from new white linen—never from rags or anything that has been used before. So carefully is the paper prepared that even the number of dips into the pulp made by each workman is registered on an automatic dial.

[Continued from SUPPLEMENT, No. 977, page 15610.]

METHODS OF MINE TIMBERING.*

By W. H. STORMS, Assistant in the Field.

GREAT CHAMBERS AND SQUARE SETS.

THE systems of timbering hereinbefore described refer particularly to veins having a width not exceeding 12 feet, though mines have been worked under great difficulties, and where the operations were attended with extreme danger, where the distance between walls was 20 and even 25 feet. An instance may be mentioned in California in the Mount Jefferson Mine, at Groveland, in Tuolumne County, where the vein was 25 feet from wall to wall. A very ingenious system of timbering was introduced in 1854, or thereabout, consisting of long stulls supported by wall and inside props 7 feet apart. Longitudinal braces, or ties, were also introduced to support the timbers longitudinally, but the support was insufficient, and a most disastrous case resulted. It is a matter of absolute impossibility, however, to recover, by the methods thus far given, all the ore from such great masses of mineral as were found in the Comstock Lode, where one ore body, the Great Bonanza, measured 340 feet in width at one point, 600 feet in height, and 1,250 feet in length. Stopes in the various mines of the Homestake group, in the Black Hills, South Dakota, range from 40 to 150 feet in width and several hundred feet in length and height. The Caledonia Mine, of this group, measured on the 300 foot level 195 feet horizontally. The Homestake vein at the surface, in the open cut, is 300 feet wide, by actual measurement.

In California there are many mines of great value that cannot be worked by any system of stulls. The Stonewall Mine, San Diego County, has 20 feet or more of vein in places. The Alvord Gold Mine, in San Bernardino County, is a very wide vein. The Odessa, Occidental, Oriental, Silver Monument, and Waterloo Mines, of the Calico District, measure 30 to over 100 feet in width. Some of the mines of Bodie have very broad veins. The Josephine Mine, in Mariposa County, has an immense ore shoot 50 feet wide. The Utica-Stickles Mine, at Angels, Calaveras County, is 40 to over 100 feet wide, and the Gover Mine of Amador has an ore body 30 to 50 feet wide. The Zeila, at Jackson, is working an immense mass of ore. The Boston Mine, near Mokelumne Hill, is 40 to 60 feet wide, and some of the ore bodies in the larger quicksilver mines are of prodigious size. In addition to these there are many other mines on the gold belt of California where the great width of vein precludes the extraction of the ore by the use of any system of stulls or simple posts and caps.

Veins and ore bodies of large size can be safely, completely, and cheaply mined by using what is known as the "square set" system of timbering, introduced in 1860, by Philip Deidesheimer, while superintendent of the Ophir Mine, on the Comstock Lode.

INVENTION OF SQUARE SETS.

The following interesting reference to early mining on the Comstock is from Monograph IV. of the United States Geological Survey, "Comstock Mining and Miners."

"At the 50-foot level (of the Ophir Mine) the vein of black sulphurets was only 3 or 4 feet thick, and could readily be extracted through a drift along its line, propping up the walls and roof, when necessary, by simple uprights and caps. As the ledge descended the sulphuret vein grew broader, until at a depth of 175 feet it was 65 feet in width, and the miners were at a loss how to proceed, for the ore was so soft and crumbling that pillars could not be left to support the roof. They spliced timber together to hold up the caving ground, but these jointed props were too weak and ill supported to withstand the pressure upon them, and were constantly broken and thrown out of place. The dilemma was a curious one. Surrounded by riches, they were unable to carry them off.

"The company was at a loss what to do, but finally secured the services of Philip Deidesheimer, of Georgetown, California, who visited and inspected the treasure-lined stopes of the Ophir."

That the ore body could not be extracted in the usual manner was at once apparent, and Mr. Deidesheimer says he set about his task with some misgivings. He did not at one stride grasp the idea of the square set, but the system which now bears his name was the outgrowth of circumstances and the very necessities of the case. He instituted a policy, however, the wisdom of which soon became apparent.

The first step was to cross-cut the vein from wall to wall, starting from a drift on the hanging wall side of the vein. As the work advanced he set up posts and placed caps above them, not across the course of the drift, as is usually done, but along the sides, the idea being to form, when completed, a line of caps which would reach continuously from wall to wall. To accomplish this the ends of two caps were placed upon each post, except at the ends. These novel sets were held in place by pieces of 2×4 scantling 4½ feet in length and reaching across the drift from near the top of a post to that opposite.

Having successfully driven the cross cut, Mr. Deidesheimer now ran a drift some distance along the foot wall, timbering with posts and caps in the ordinary manner; that is, the caps were placed upon the posts at right angles to the drift and parallel with those in the cross cut. The posts in each case were set perpendicular. Returning to the point where these operations were begun, a second section by the side of the first cross-cut was taken out and timbered with a single line of posts and caps, the 2×4 scantling being placed as in the first case. When this section was completed there were standing three lines of posts surmounted by three lines of caps, extending from the foot to the hanging wall. This was not really a new idea, as Mr. Deidesheimer had previously employed the same method in his drift mine on Forest Hill, when the breast was carried in 125 feet wide, the roof being supported by rows of posts with continuous caps.

The work thus far performed in the Ophir revealed the fact that an extremely rich body of ore extended upward from the level where this work had been done. The miners were directed to commence stoping upward in the body of soft, black, crumbling ore, and soon a considerable excavation had been made. It became evident that the ground must be secured at once.

In the Georgetown Mine, that Mr. Deidesheimer had left but a short time before, the vein was vertical, and the walls were so soft and crumbling that in or[illegible]r to stope out the mineral he had resorted to the exp[illegible]dient of setting one post directly above another, th[illegible] lower end resting on the cap, and in this way he [illegible]anaged to work the vein without much difficulty.

The Georgetown experience suggested the idea of adopting a similar plan in the Ophir. Accordingly, Mr. Deidesheimer had a mortise cut at the junction of two caps, which were already in place, and having a post framed with a tenon to fit, set the post in place directly above the one resting on the floor below. In a short time four posts were in position with the caps upon them as below, together with the frail 2 × 4 scantling, the office of which was to keep the other timbers from falling down. The first "square set" timbers, it will be seen, were framed in the mine, the mortises being cut in the timbers in place. The work

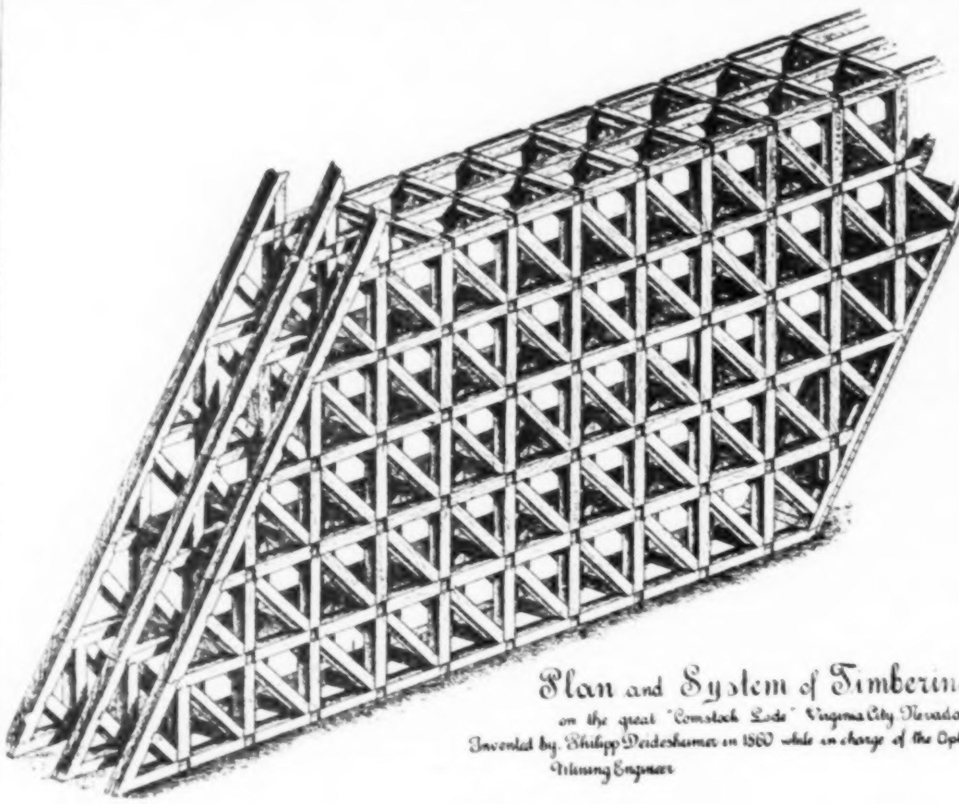


FIG. 32.

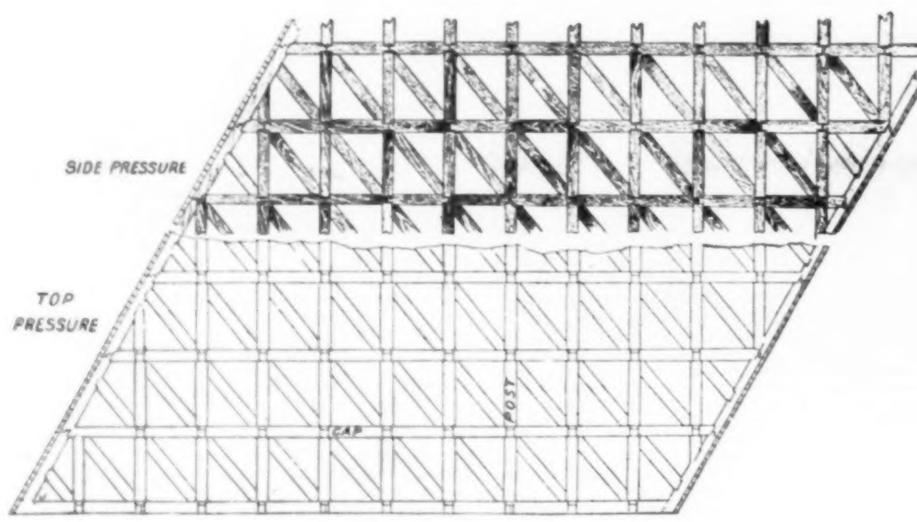


FIG. 33.

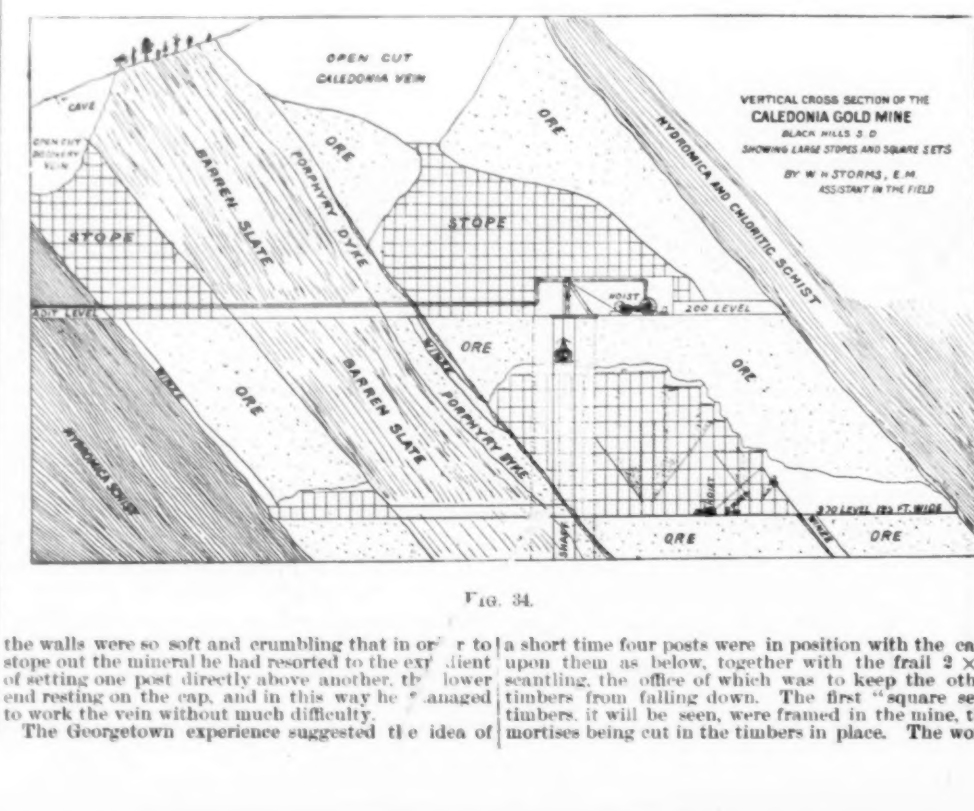


FIG. 34.

* From Bulletin No. 2, California State Mining Bureau. Dr. J. J. Crawford, State Mineralogist.

of extracting ore proceeded slowly yet, for the ground had to be secured as well as possible. It soon became evident, however, that something more substantial than 2 × 4 scantling would be required to keep the timbers in position, and it was determined to put in timbers of the same dimensions as those forming caps and posts. This was done at once, and the "square set" was complete in principle, though not in detail. The caps occupied all the space on top of the posts, leaving no resting place for the "ties," which had to be supported in some other manner. As they were looked upon as simply an auxiliary—a support to the posts and caps—they were only required to be held in position. Accordingly a lot of iron spikes were made, in shape somewhat like the thumb, having a sharp point at one end, the other end having a face three-fourths of an inch square.

Two of these spikes were driven into a post at the proper height, and two in the post opposite, and the tie placed so that the ends rested upon these iron lugs, wedges being driven in at the ends to secure firmness. The posts and caps were now framed on the surface and delivered below, ready for use wherever needed.

The work of mining now progressed much more rapidly and the problem seemed solved. Soon after it was determined to frame the timbers so that the ties might also rest on the posts. The stopes becoming of such great size, the dimensions of the timbers were increased and they were then framed, as shown in the accompanying illustrations.

As the work progressed, slight changes were made from time to time whenever any improvement seemed possible. Sills were laid upon the floors of the levels as a foundation for the timbers above, which had now assumed massive proportions. The sill timbers were cut as long as it was possible to get into the mine. The men who were obliged to handle these ponderous timbers could see no reason why the sills should be longer than the caps, and had from the first looked upon the growth of this new system of timbering with much prejudice. When the great stopes were carried up from level to level the wisdom of the use of long sills became apparent, as they permitted the removal of all the ore and the placing of timbers without danger or loss, which could not have been accomplished with short sills, as when breaking up through the floor of a level from below short sills would have nothing to sustain them.

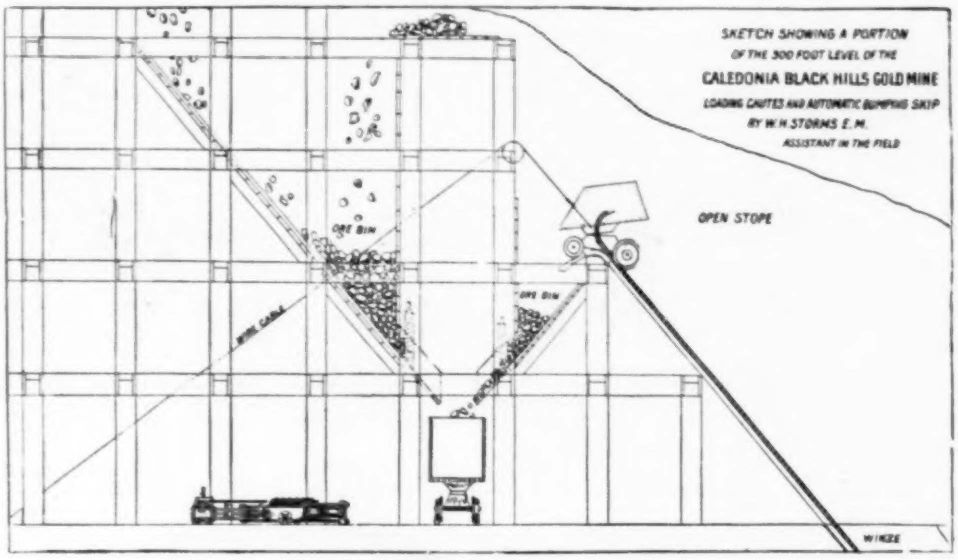


FIG. 35.

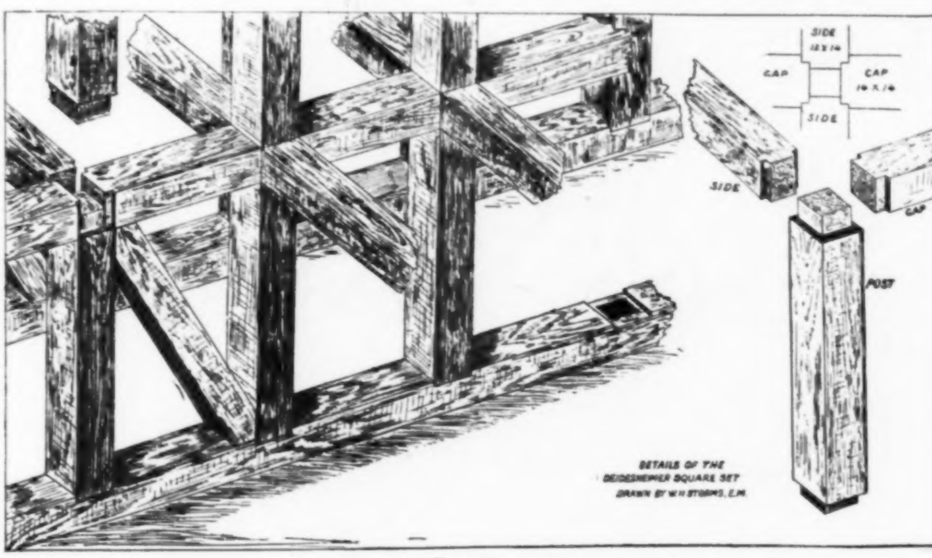
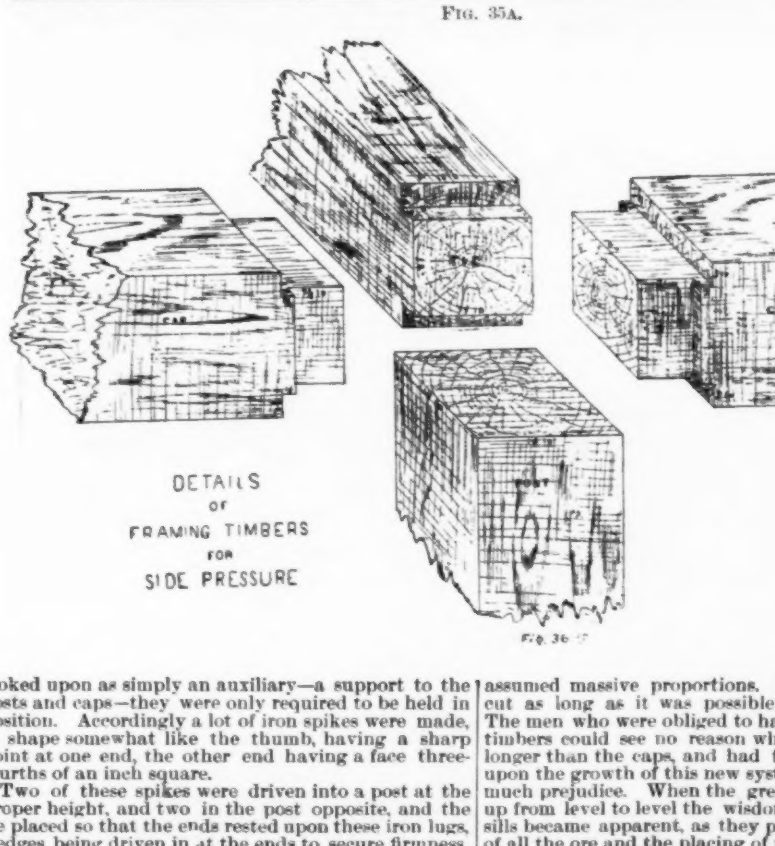
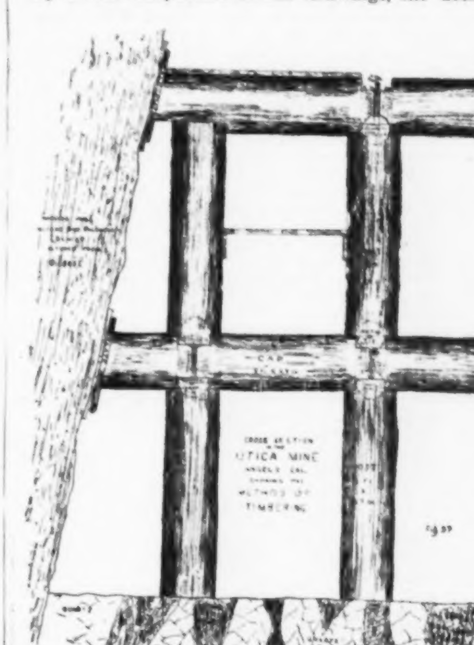


FIG. 35A.



When, in the course of ore extraction, the work reached the walls, additional timbers, called "wall plates," were put in, as shown in the sketch of timbering in the Ophir Mine. The caps were extended from the nearest post to the wall plate, except when a post came within two feet of the wall plate. In such case the cap extended from the wall plate to the second post in a single piece.

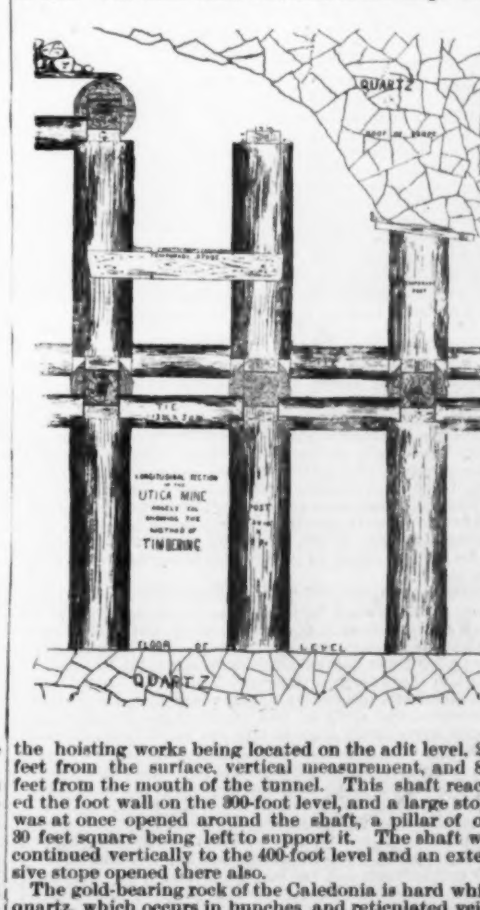
By a close inspection of the drawings, the details



may be plainly seen. It will be noticed that a system of braces reaching diagonally across the sets was also introduced, as well as close lagging on the walls. There is no doubt that the Ophir was the best timbered mine in the world, but the Comstock miners, who gladly adopted the Deidesheimer system, soon began to disregard many precautions which to them seemed unnecessary. The diagonal braces were left out, and the ground was found to stand about as well. Then, anxious to still further reduce expense and hurry the work of extraction, the lagging on the walls was dispensed with, and later, in somewhat firmer ground, the wall plates were left out, and finally the timbers were placed in rectangular sets, with only a few props here and there to the walls and roof, as shown in the drawing of the Caledonia Gold Mine. The disregard of these important details in American mines has resulted in numerous disastrous caves.

Owing to the careless timbering in "Big Bonanza," in the California and Con. Virginia Mines, cribs of solid timber had to be built, reaching from the floor to the roof.

The sketch of the Caledonia Mine in the Black Hills, S. D., represents the mine as it appeared in the spring of 1883. The main shaft was sunk in the large vein,



the hoisting works being located on the adit level, 200 feet from the surface, vertical measurement, and 820 feet from the mouth of the tunnel. This shaft reached the foot wall on the 300-foot level, and a large stope was at once opened around the shaft, a pillar of ore 30 feet square being left to support it. The shaft was continued vertically to the 400-foot level and an extensive stope opened there also.

The gold-bearing rock of the Caledonia is hard white quartz, which occurs in bunches and reticulated veins in chloritic schist, and in this respect resembles some California mines, as the Utica-Stickles, Gover and some

others. In the Caledonia great headers were excavated in advance of placing the square sets. The timbers were all properly framed and were massive, but there was a disregard of what were considered the minor unnecessary details in placing them, particularly on the walls and against the roof. As these large stopes were extended, too broad an area was taken out at one time, and the superincumbent weight at length threw the timbers out of line, and almost without warning the mine caved, the immense timbers "jack-knifing" and snapping like reeds. Thousands of tons of ore, the expensive machinery, and a mass of splintered timbers were dumped in a chaotic mass to the bottom of the 400-foot level. There were three causes which led up to this disaster: the extraction at one time of too large an area of ground; carelessness in timbering and the slippery nature of the foot wall (talc schist), which afforded a poor support to the large pillar of ore.

It is unreasonable to expect a frame of timbers, however strong, to support the weight of a mountain of rock, and for that reason discretion should be used in extracting large bodies of ore. It is hazardous to attempt to remove a section more than three or four sets wide at one time from the floor of one level to that next above. A breast may extend entirely across the deposit or vein, but if more than four sets in width are removed at one time, it allows too much weight to fall upon the timbers, and the probability of a cave is greatly increased.

By taking out a section, which may extend entirely across the vein or deposit, three or four sets wide, and carrying the stope up somewhat in the form of a pyramid, so that on nearing the floor next above only the space of a single set, or at most not more than two, be at first removed, and the timbers firmly wedged to the sills before enlarging the excavation at that point, all the ore may be extracted, and the operation in this manner is attended by the least expense and danger. When a section has been mined out from level to level as described, a second section may be attempted. Under all ordinary circumstances it will be found that the timbers will usually support the ground until the stopes can be filled with waste. At many mines waste is obtained on the surface, and in some the opening of large chambers in the hanging wall is necessary to obtain a sufficient amount of material for filling the stopes. There is always danger in the removal of a mass of rock which stands on a base that is broader than its upper portion or apex, like the letter "A," while, on the other hand, a "V" shaped mass is largely supported by the walls. Many ore bodies are lens-shaped; that is, broader at the center than those portions either above or below; and in these masses the greatest expense and danger attend the removal of the upper portion.

(To be continued.)

THE AQUIDABAN IN DOCK AT COBRAS ISLAND—SHOWING THE DAMAGE DONE BY THE WHITEHEAD TORPEDOES.

On March 30 news was received from Rio de Janeiro that the Brazilian government fleet was preparing to sail for the south in chase of Admiral de Mello's ships, the Aquidaban and Republica. On April 9 news came that the insurgent vessels had forced the bar at Rio Grande; but ten days later a telegram stated that the insurgents had been repulsed and the Aquidaban sunk by the torpedo boat Gustavo Samplo. The Samplo accomplished this result by using three Whitehead torpedoes. The Aquidaban was subsequently recovered, and put into dry dock, where she is being repaired.

[From the Technic.]

SOME PRACTICAL POINTS IN WATER SUPPLY ENGINEERING.

When the Board of Editors honored the writer by a request to prepare something for publication in the Technic, it at once occurred to him that a short paper on the subject above given might prove acceptable to the younger members of the society. Should any of the graduate members who have had experience in water supply work find anything of practical interest or value in the following lines, its mission will have been more than fulfilled. The limits of the paper will not permit any very thorough discussion of the subject, yet it is hoped that some points may be covered that will be of value to those who have studied the text books bearing upon water supply engineering, but who have had no practical experience.

WATER SUPPLY.

When employed by a town proposing to construct a system of water works, the first duty of the engineer is to make an investigation for the purpose of determining the best source of supply. An ample supply of potable water is absolutely necessary, and that it be a gravity supply is very desirable. The methods of making extended hydrographical investigations have been fully explained in the text books, but it remains for the engineer to see that the necessary investigation is thoroughly made. In the so-called arid and semi-arid regions of the West, the question of obtaining an ample supply of good water is one not often easy of solution.

With the majority of the members of the town council, in almost every instance, the tendency will be to greatly overestimate the quantity of water that may be obtained from a given source in times of minimum flow; and their instructions will often be to proceed with the designing of the works, after an exceedingly superficial examination as to the supply. Right then it becomes the duty of the engineer to insist that a proper investigation as to the probable quantity and quality of the water be made under his instructions, and, if necessary, under his own personal supervision.

If the supply is to be from wells, he will have a test well dug at the site selected for the wells, and will cause the flow to be thoroughly tested by means of a pump; if from springs, he will have them cleaned out and opened up at time of minimum flow, and test by weir measurement, if necessary; if from a small stream, he will at the best point near the proposed location of the headworks, and at the lowest stage of the water, put in a weir and measure the flow. Pay no attention as to guesses as to quantity, made by the "oldest settler;" nor is it wise to accept the results of measurements made by any resident surveyor or engineer, unless he is known to be competent to make such measurements accurately.

While looking into the matter of supply, it is always advisable to take into account the probable future growth of the town. In agricultural regions, where the growth is slow and steady, it is well to be sure that there can be obtained at the headworks a supply of one hundred gallons per capita per day for a population double that of the town in question at the time the investigation is being made.

PLANS.

In planning the distributing system, the probable direction, or directions, of future growth of the town should be taken into consideration; and in proportioning the sizes of the mains, the designer should provide for the population doubling in number well within the life of the works. The principal mains, which will generally be arranged in parallel lines, should be connected together by the smaller cross mains, in order that a free circulation of the water may be maintained; and "dead ends" should be avoided as much as possible. When making the calculations for determining the diameters of the main pipes, it will be found that the flow necessary to provide for the domestic consumption is so insignificant as compared with the flow necessary for fire service, that practically it may often be disregarded. Provision should always be made for a liberal number of fire streams, of from 200 to 240 gallons per minute each. There is perhaps some variance of opinion as to the proper number of such fire streams that should be provided for in any given case, but the following rule is probably a safe one to use: For a town of 5,000 inhabitants, provide for four fire streams; for 10,000 inhabitants, six streams; for 15,000 inhabitants, eight streams; for 20,000 inhabitants, ten streams; for 25,000 inhabitants, twelve streams.

There is opportunity for the exercise of considerable ingenuity in the selection of points in the distribution for the location of gates and hydrants that shall give an economical and, at the same time, most effective arrangement. Their cost is usually but a small percentage of the total cost of the works, and they are such important adjuncts to the system that it is false economy not to distribute them with a very generous hand.

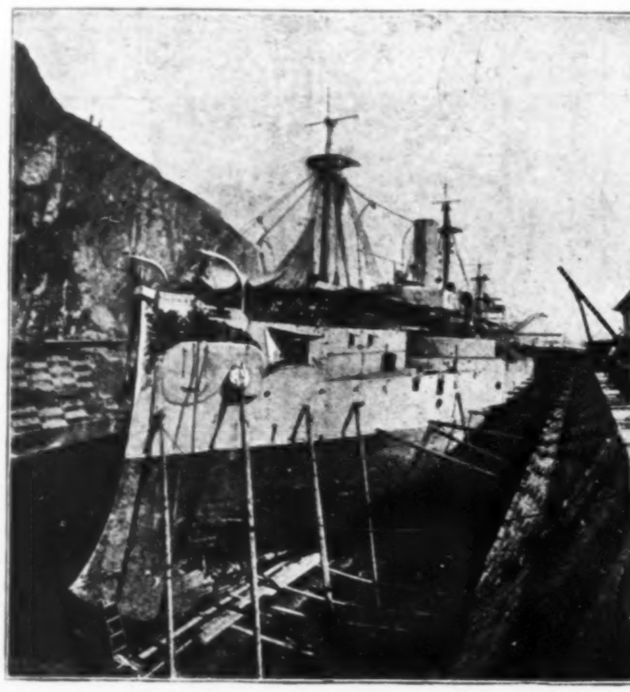
The natural conditions surrounding the site chosen for the location of the distributing reservoir will usually govern as to the best and most economical plan for the reservoir. Stone that is suitable for masonry, or clay that will make an excellent puddle, may be found on the site itself. The site should be chosen at such an elevation as will give, in the main part of the town, a pressure in the hydrants of from 65 to 100 pounds per square inch. A hydrant pressure of 80 pounds is about right, and it should not exceed 100 pounds. As to the size of the reservoir, the same rule should govern as for the sizes of mains; that is, assume a population double that of the town at the time, and then plan a reservoir of a capacity sufficient for the storage of at least two days' domestic consumption. It frequently happens that the funds provided are insufficient for the proper construction of the entire works; and in such cases, it is not wise to try to economize by reducing the sizes of the mains, or by devising too cheap a plan for the reservoir. It is better to reduce the size of the reservoir, and endeavor to plan one that shall be a substantial, safe and permanent structure. It will be much easier afterward, when the growth of the town demands it, to increase the capacity of the reservoir than that of the mains.

Should the town not be fortunate enough in its location to render a gravity supply practicable or possible, then a pumping plant is necessary. An entire paper, or several of them for that matter, could profitably be devoted to this subject alone, but we can only touch upon a few points in passing. Often the funds are too limited to permit of any attempt at architectural effect in the design of the pump house, but it should be ample in size and substantial in construction, with plastered walls and tightly boarded ceiling. Provide solid masonry foundations for the pumps, and locate them as close to the boilers as convenient, in order that the steam pipes may be short. Locate the pump house close to the source of supply and specify a suction pipe of ample size, in order that the frictional head in the suction pipe may be small when the pump is working. Provide for a gate in the force main just outside of the pump house, so that the pumping plant may be cut off from the rest of the system when necessary. Provide for an air chamber on the pump, of proper size; for a check valve, to be placed on the force main next to the pump; for a relief valve, to be connected with the force main at a convenient point inside the pump house; for a charging pipe connecting force and suction pipes; and for all other appliances necessary to put the pumping plant in perfect working order. To get the force main from the pump into the ground, two ells are generally used, either 45° or 90°; one, put in the main soon after it leaves the pump, to make the turn from the horizontal to the oblique or vertical; the other, used in the trench at the proper depth below the surface of the ground, to make the turn back to the horizontal. Plan a suitable masonry backing for the ell in the ground, to prevent its joints being started by the action of water ram. It is well to locate the relief valve on the force main a few feet further away from the pump than this ground ell. Be careful to plan a smoke stack of proper height and size, and to make the specifications for the boilers and appurtenances full and complete. Provide for a proper boiler feed pump, a feed water heater and an injector. Plan a rather deep pit in front of the boilers, and inclose it within brick walls. Some firemen like to have the heat, when the fire doors are open, strike them in the upper part of the body, some in the lower part, and the pit can be filled up afterward to the depth desired. Plan a fuel car and track for convenience in handling the fuel and firing the boilers.

CONSTRUCTION.

All pipes, before leaving the factory, should be subjected to a successful test of 300 pounds per square inch hydraulic pressure. In order to inspect the pipes properly, it is necessary to wait until unloaded from the cars; then examine each piece separately, to see that it is concentric and straight, and at the same time pay attention to the following points: Ascertain by weighing a number of pieces, and by measurements, whether all pipes meet the necessary requirements as to thickness. In weighing pipes, due allowance must of course be made for the weight of the preservative coating. If the pipe is of wrought iron, carefully examine all seams, to see that the shop work has been properly done. See that none of the pieces have been seriously injured by friction with each other, or by accident, in transit, and that all metal has been thoroughly cleansed from rust and dust before receiving the preservative coating. Care must be taken to keep the coating as nearly intact as possible while the pipe is being unloaded and distributed throughout the town. After being distributed, it should be carefully examined piece by piece, and wherever the coating has been damaged, should be cleaned with a stiff brush, and then receive a thick coat of asphaltum paint. If any pieces are too badly rubbed and scarred for the coating to be repaired in this way, they should be redipped.

Street mains should be located on one side of the street, at a convenient distance from the property lines, say twenty feet. It is not necessary that the mains be laid to an exact grade, but the lines should be staked out, in order that the trenches may be straight. The trenches should be dug to such a depth as will give a covering over the mains of from three to five feet, according to the climate, and to a width at the bottom of about one foot in excess of the diameter of the pipes. It is important to avoid summits; but where one is unavoidable, place it at a hydrant connection; or if this cannot be done, put in an air valve. Several lengths of pipe should not be joined together on the surface of the street and then be laid in the trench, but the pieces should be laid joint by joint in the trench, care being taken to keep the line straight and to make it conform to a reasonably uniform grade.



THE AQUIDABAN IN DOCK AT COBRAS ISLAND—SHOWING THE DAMAGE DONE BY THE WHITEHEAD TORPEDOES.

See that bell holes are properly dug and all joints let into the earth, so as to secure a uniform bearing for the pipe along its entire length. In crossing a gully or small watercourse it is best, if practicable, to lay the pipe beneath its bed, and to dig the trench deep enough on each side to avoid making a sag in the line. If this cannot be done, then it is well to carry the pipe across in a box, or in embankment, and provide for the drainage underneath by a culvert. When a sag in the pipe line is unavoidable, a blow-off should be put in to flush out the sediment that is sure to collect there. Great care should be exercised that no dirt, stones, or obstructions of any kind are left in the pipe when laid. The calking should be thoroughly done, and wherever the pipe coating is damaged in process of jointing, it should be renewed with asphaltum paint. If practicable, water should be turned into the pipes before the trench is refilled, in order that a reliable test of the tightness of the joints may be had. A good many "expert" foremen seem to believe that a leak will always show itself at the surface after the refilling has been done, but when the pipe is in gravelly or rocky ground there is no certainty of its doing so. When admitting water into the pipes keep hydrants open, to allow free escape for the air. The refilling should be done carefully and equally on both sides until the pipe is covered, and the material should be settled with water at the time of refilling, in order that there may be as little after settlement as possible.

The special fittings, tees, ells, crosses, etc., should conform in safe tensile strength with the plain pipes they are intended to join, and the castings should be duly thickened at flattened and curved parts. The inner entrances should be well rounded, in order that there may be as little frictional loss as possible. All tees, ells, and plugs, when laid, should be thoroughly backed with stones or masonry, to help take up the thrust of the water. It is also well to use some locking device, to fasten the specials firmly to the pipes.

Gates should be subjected before leaving the shop to the same test for strength as the pipes, and under such test should prove themselves to be reasonably tight, nothing more than a very slight leakage being permissible. They should be so constructed as to require at least ten complete revolutions of the screw to open or close them, and before allowing them to go into the work, they should be tested to see if they meet this requirement. A uniform system as to the location of the gates in the distribution should be strictly adhered to, and probably the best plan is to set them at street intersections truly on the block lines. Each gate should be inclosed in a gate box, or if large, in a masonry manhole provided with a suitable cover.

Hydrants should also be subjected to a successful test of 300 pounds hydraulic pressure per square inch before leaving the shop, and should require at least ten complete revolutions of the screw to close them. The stand pipe and valve openings should be large, so that the loss of head by friction in the hydrant itself may be kept as small as possible. The length of the stand pipe should be such that when the hydrant is properly set with reference to the pavement line, the top of the pipe connecting with the street main, at the point where it is joined to the base of the hydrant, shall be a few inches higher than the top of the street main itself. Care should be taken to see that the hydrant nozzles are made to fit the couplings on the hose belonging to the town. The connecting pipe from the street main should not be of a less diameter than six inches, and if the hydrant is provided with a steamer nozzle in addition to the usual two hose nozzles, it should have a diameter of eight inches. Hydrants should be set in a truly vertical position, and be placed on line with the front of the blocks, just inside the edge of the sidewalk. Each hydrant site should be excavated to a width of two feet, and to a depth of two feet below base of hydrant. In order to provide free drainage for the waste water from the hydrant, this hole should be filled up with loose rock or bowlders to a point about two feet above the base of the hydrant, and the rock filling be covered with pieces of board to prevent fine material from falling in and filling up the interstices between the rocks. The hydrant should be compactly backed to prevent danger of its being forced from its connection by water ram, but care must be exercised in placing the backing to see that the waste hole for the escape of the water from the base of the hydrant is left unobstructed. If hydrant is placed in a manhole, provision should be made for the proper drainage of the manhole, in order that the waste water from the hydrant may cause no trouble.

The constructing of the distributing reservoir is generally the most important part of the entire work, and an assistant engineer should be present at all times to give points and grades and to see that the work is done strictly in accordance with the plans and specifications.

No part of the work needs more attention than the construction of the reservoir embankment, and yet with the inexperienced, no part is likely to receive less. The best materials available should be used, and everything be done to render the embankment solid and impermeable by watering and rolling the material in irregular layers. Sometimes, when convenient, herds of goats, sheep or cattle are driven back and forth over the embankment to consolidate it thoroughly; and the more wheeling and walking over it, the better. All sod, stubble, or other vegetable material should first be removed from the ground for a considerable distance back from the foot of the inside slope, and the subsoil be rolled and compacted with a heavy grooved roller. Waste material should be deposited on the lower side, so as to re-enforce the embankment.

Such masonry work as is necessary should be in every way superior to that performed by the average mason, and that it shall be impervious to water is the all-important quality. The masonry work should be thoroughly wet with a hose at least twice a day for not less than a week after same has been put in place, and oftener if evaporation is great. No wheeling or working upon fresh work should be allowed.

In the making and laying of concrete, care should be exercised to see that the materials used are clean and good; that they are thoroughly mixed in the proper proportions; that, before mixing, the stone or gravel be wet with clean water; that just the necessary quantity of water be used in mixing the mortar, and no more; that the ramming be only sufficient to thoroughly consolidate the materials, and not so severe as to cause the stone or gravel to settle to the bottom and the mortar to be forced to the top; that in doing the ramming, concrete previously laid be not disturbed; that before any layer be covered by another its surface, if dry, be well sprinkled with water to secure a good bond. In hot, dry weather it is advisable, in addition to wetting it, to protect concrete by covering from the sun.

What is said in the above paragraph about concrete may also be said in a general way of other masonry work. The mortar should be first class in every respect; the stones used should be cleaned and moistened with clean water; they should be well bedded and bonded; all voids should be compactly filled with spawls and mortar; joints should be close and be broken both horizontally and vertically; and no stones should be moved after the mortar has begun to set.

Great care is necessary in the making of clay puddle. When properly made it is nearly as valuable a material as concrete, but when carelessly made it may be worse than useless. The materials used should be carefully selected, properly proportioned, and thoroughly compacted. If the compacting is done by ramming, the surface of each layer should be deeply scored to make bond with the succeeding layer; if by rolling, a heavy grooved roller should be used.

In the whole process of the design and construction of a reservoir, the engineer should bear in mind the fact that "water abhors an angle," and should lose no opportunity to put one in its way whenever it is likely to try to force a passage out. The utmost care must be used to prevent the water following along the pipes in the entry trench, by inclosing them in masonry and building cut off walls across them at intervals. Water is the most subtile enemy with which an engineer has to deal, and every precaution known to man must be taken to prevent its working through the embankment—even then the work may result in partial failure.

R. C. GEMMELL, 1884.

THE AQUEDUCT BRIDGE OF LA FRETTE.

THE AQUEDUCT BRIDGE OF LA FRETTE.

THE rendering of Paris and the Seine salubrious, which formed the subject of the law of April 4, 1889, has had, as a result, the construction of an aqueduct ten feet in diameter that starts from Clichy and runs through Asnieres, Colombes Argenteuil, Cormeilles and Herblay toward the waste lands of Acheres (forest of Saint Germain).

The aqueduct crosses the Seine for the first time between Clichy and Asnieres by means of the Berlier siphon; for the second time at Argenteuil over a metallic bridge, serving at the same time as a road bridge; and for the third time at Herblay through a siphon about 650 feet in length, submerged during the campaign of 1893.

In addition to these works, which are on the point of being finished, it has been necessary, for the crossing of the great ravine of La Frette, to construct an aqueduct bridge, which traverses it at a height of 40 feet. This work consists of four arches of 60 foot aperture,

the extreme ones having embedded buttresses. The foundations consist of blocks of concrete that rest upon fine sand or upon the limestone of Saint Ouen.

The masonry of the piers and vaults is of Souppes stone, and the aqueduct that surmounts the work is of tufa. The mortar used consisted of 25 pounds of Portland cement per cubic foot of sand.

The fascia of the vaults are of ashlar, with bossages, the tympans of close-scabbled ashlar, and the string course and cornice of bush-hammered stone.

In order to ease the work and reduce the cube of the masonry, three vaults have been formed in each of the tympans.

The vaults, whose thickness at the key is 30 inches, were constructed in two parts, so that the charge could be distributed more quickly over the entire surface of the centering, without having to overcome the bulging produced by the charge of the haunches.

The removal of the centering, effected six days after the putting in of the keys, showed a settling of but $\frac{1}{25}$ of an inch. Each center consisted of four frames spaced 5 feet from axis to axis and rested upon 24 sand boxes.

The construction of this bridge, begun on the 20th of March, 1894, was finished on the 4th of August, and does honor to the distinguished engineers, Messrs. Bechmann and Launay, and the contractor, Mr. Chagnaud.—L'Illustration.

HEATING POWER OF SMOKE.

By R. R. TATLOCK, F.R.S.E., F.I.C., F.C.S.

IT appears to be generally understood that a large percentage of fuel is lost in the smoke which issues so abundantly from most chimneys, and random statements have been made to the effect that the loss in heating power due to this passing away of combustible matters in smoky furnace gases may reach as high as 30 per cent. of the whole. A little consideration, however, will show that the loss of any large percentage of combustible matter, and consequently of heating power, is quite out of the question. This may be proved in two ways—1, by calculation of the two sources of heating power as shown by an analysis of coal or dross used for steam raising, and 2, by actual analysis of the furnace gases for combustible solids and gases.

In the following paper are given the results of these two methods of observation, the same dross being analyzed and also employed as fuel in a works furnace, from which smoky gases were given off which were tested for combustible matters.

1. The following is the analysis of the dross employed:

	Per cent.
Gas, tar, etc.	37·63
Fixed carbon	49·97
Sulphur	0·40
Ash	2·72
Water	9·28
	100·00
Heating power (practical) due to gas tar, etc.	1·16
Heating power (practical) due to fixed carbon	6·49
	7·65

The points to be observed are the relative proportions of heating power (represented in the analysis by the number of pounds of water at 212° F. capable of being evaporated to dryness by 1 lb. of the fuel) given out respectively by the combustion of gas, tar, etc., and by the fixed carbon. These are calculated according to Playfair's well-known formula, which was practically tested on coals intended for the British navy, and which shows that while 1 lb. of fixed carbon is capable when burned of evaporating 13 lb. of water at 212° F. to dryness, 1 lb. of the gas, tar, etc., will only evaporate 3·1 lb. From these figures it appears that in the coal or dross the gas, tar, etc., only contribute 15 per cent. of the total heat given out during the combustion, and that the fixed carbon produces the remainder, or 85 per cent. In coals with less of the former ingredients and more of the latter, which is commonly the case, the proportion given out by the volatile constituents would be considerably reduced. It is thus perfectly clear that even though the whole of the volatile matters (which can alone be accountable for any loss of combustible material) escaped combustion, there could not possibly be a greater loss of heat than 15 per cent. of the whole, even in such an extreme case as this represents.

2. An analysis was made of the furnace gases given off during the burning of the dross, of which the results are given above, with the following results:

	Gases very smoky Per cent. by volume.	Gases almost free from smoke. Per cent. by volume.
Carbonic acid	5·0	3·5
" oxide	none	none
Hydrocarbons	trace	none
Nitrogen	79·9	79·9
Oxygen	15·1	16·6
	100·00	100·00

It has been asserted that carbonic oxide is given off in considerable quantity when much smoke is being produced, but it does not appear in this case; and Hempel, in his work on "Gas Analysis," comes to the conclusion that little or no combustible gases are present in furnace gases. In the volume referred to (page 205) Hempel says "furnace gases usually contain only carbon dioxide, oxygen, and nitrogen. All other gases are present in but very small amounts. In oft-repeated analysis the author has always found only traces of carbon monoxide, methane, and the heavy hydrocarbons." This is in complete accord with the analyses given above, and it may be taken for granted that the presence of carbonic oxide or other combustible gases in furnace gases is a most unusual occurrence. This is quite conclusive evidence that no appreciable loss of heat, even when the furnace gases are smoky, can be attributed to the passing away of the products of imperfect combustion in the gaseous form at least.

That there is loss of combustible matter in the smoke is an undoubted fact, but the quantity seems also to be greatly magnified in certain random statements. In the experiment referred to above the soot was also collected during one hour and a half with following results:

	Grains per 100 cubic feet of furnace gases.
Carbonaceous matter	30·81
Ash or mineral matter	20·65
Total soot	51·46

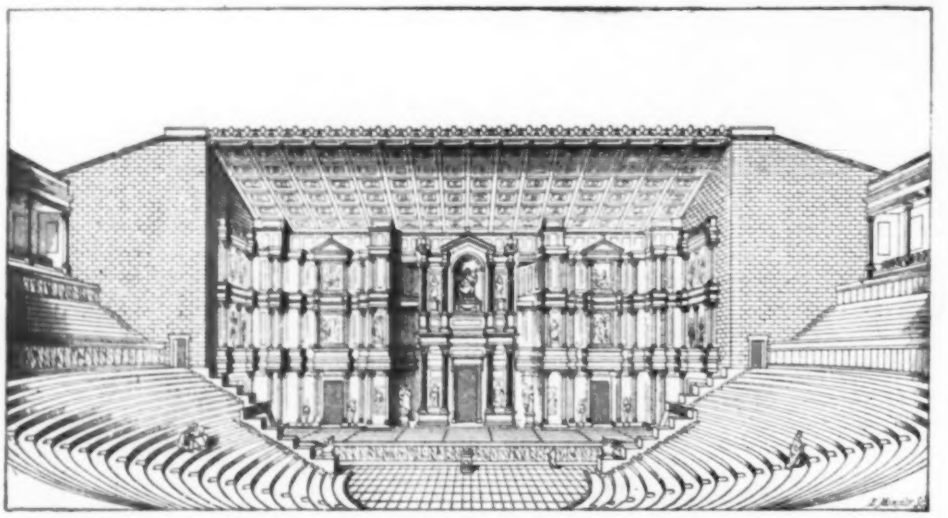
It will be observed that the soot collected consisted largely of mineral or incombustible matter. In several experiments to estimate the soot in furnace gases similar results to those were obtained, and the average would come very close to the quoted results of this special test.

To find how much carbonaceous matter was actually lost as smoke, it will be necessary to know the number of cubic feet of furnace gases given off by the combustion of say 1 ton of the dross. If the percentage of carbonic acid in the furnace gases is taken at 5 per cent. the total volume of these given off from one ton of dross would be about 940,000 cubic feet measured at the ordinary temperature and pressure, and this would contain 41 lb. of carbonaceous matter and 27 lb. of mineral matter. This would represent 1·83 per cent. of the volatile matters (gas, tar, etc.) given in the analysis of the dross; and if from this is now calculated the heating power according to Playfair's formula, it will only come to 0·057. This figure, compared with the practical heating power (7·65) of the dross, goes to show that the solid combustible matter of the smoke can only account for the very small percentage of 0·74 of the total heating power which can be obtained from the coal.

From the results of these experiments it is evident that the loss of combustible matters in smoke is very small indeed, and that the belief in immense loss by this cause is simply a fallacy, and it is decidedly not corroborated by experiment. In adopting methods of removing the smoke nuisance, it must therefore be borne in mind that there is little or no gain in burning smoke, and that other methods of dealing with the problem, such as Dulier's smoke absorption process, ought also to receive consideration.—Chemical News.

THE THEATER OF ORANGE.*

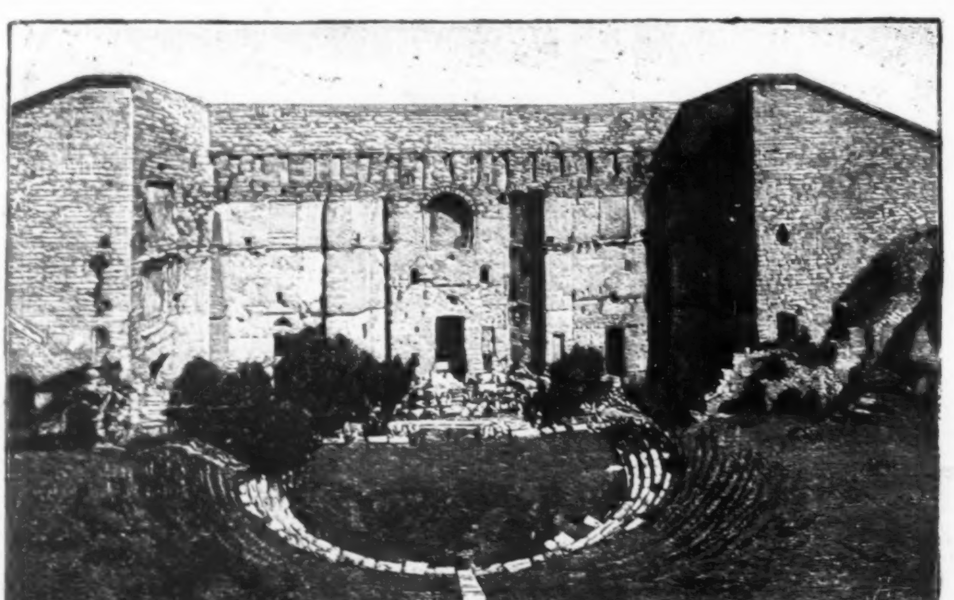
THE representations that the Comedie Francaise is preparing to give at the theater of Orange bring into question the problems of archæological architecture that concern the material organization of the ancient theater. Even after the beautiful work of Caristie upon the theater of Orange, the works of Garnier and Heuzey upon the same subject, and the somewhat superficial note of Saint Saens upon the scene painting of Roman antiquity, obscurities and difficulties still remain, and it is not in France that one has best worked at disentangling and clearing them up, as we may assure ourselves upon reading the names of those best informed upon the subject, Bottiger or Sommerbrodt, Wecklein or Benndorf.



THE THEATER OF ORANGE—VIEW OF THE STAGE IN ITS PRIMITIVE STATE.

The present representation of Antigone and Œdipus Tyrannus, at Orange, will be very far from reviving the ancient theater at all points. There is a lack of certain elements that it would take too long to enumerate, from the high buskin or the trumpeted mask up to the evolutions of the chorus in the orchestra. The occasion is an opportune one, however, for imagining what the spectacle must have been seventeen or eighteen hundred years ago. We must represent to ourselves one of those glorious mornings upon which the theater overflowed with spectators, among whom the togas and laticlaves of the Romans stood out in relief from the brown background of the Gaulish sayons to the number of thirty thousand. The largest of our modern halls is full when it contains three thousand five hundred persons.

The principal part of an ancient theater recalls the religious origin of the dramatic art when it was entirely devoted to the worship of Bacchus, the Dionysos of the Frogs of Aristophanes; it is the thymele, the altar of the god, upon which was celebrated the inaugural sacrifice, and which may be seen at the foot of the stage, in one of the accompanying engravings, at the place now occupied by our orchestra leaders. The rest of the theater comprised three parts: the benches for the public, the stage for the actors and the orches-



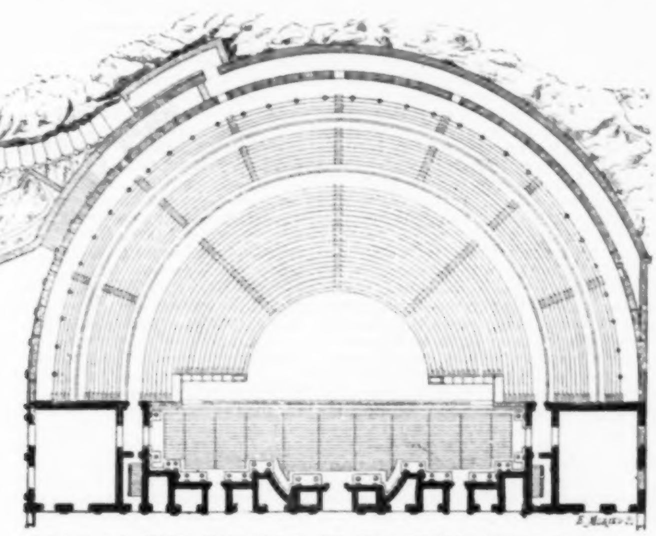
INTERIOR OF THE AMPHITHEATER.

* Anciently Aurasio, a town in the southeast of France, in the department of Vaucluse, remarkable for the Roman antiquities found in its vicinity, among which there is a splendid triumphal arch, almost entire, about 64 feet in length and breadth, and rather more in height. In the middle ages this town was the capital of a principality, which, for a considerable period, belonged to the house of Nassau. On the death of William III. of England., the King of Prussia, his heir, ceded it to France, but the title Prince of Orange is still retained by the royal family of Holland.

tra (in the place now occupied by our orchestra chairs) for the chorists.

Of the benches, there is nothing interesting to say. They were amphitheatral, protected by velums, and arranged in concentric semicircles by sections and perforated by stairways that led to the arcades of the external facade in the street. Above, a circular covered gallery (peripatos), with colonnades, served as a promenade. The priest of Bacchus occupied the place of honor in the front row opposite the stage.

Let us go down into the orchestra. It is a semicircle, of which the flooring is very smooth. In our day the authorities are seated here, but formerly it was the domain of the chorists. There were, on an average, twelve chorists, who were led by a corypheus, whose business it was to recite alone the short couplets of two



PLAN OF THE THEATER IN ITS PRIMITIVE STATE.

or three verses. As for the strophes, these, as we all know, were chanted and danced simultaneously to the sound of the flute. The entire chorus went from left to right, and that was the strophe (a revolving motion), and then from right to left, and that was the antistrophe. These dances occupied the between-acts. Among the ancients, the spectacle was interrupted and a tragedy was played, all of it at once. Attention and interest were concentrated therein. There were neither distractions nor diversions, in the sense of Pascal. During the acts the chorists seated themselves upon the steps leading from the orchestra to the stage. In Greece they were not paid by the director, but by the candidates for election, who courted the favor of voters by offering fine spectacles and beautiful costumes. Save with rare exceptions, the chorus did not enter the orchestra by way of the stage, but, six on each side, through lateral doors under the benches at the place

PRESENT APPEARANCE OF THE STAGE AND AMPHITHEATER.

now occupied by our front boxes, and that opened at each side at the foot of the stage upon the semicircle. One of them may be seen in our last engraving between the stage and the first benches.

Let us ascend to the stage. This was barred by a high structure that formerly represented a royal palace, with large windows and bays, pilasters, statues, niches and marble gods. This decoration, as well as that of the sustaining wall that raised the stage above the orchestra (hyposcenium) was always sumptuous. Vitruvius even blames the affectation of it: "One erects reeds, shafts of candelabra supporting figures of edifices from the pinnacle of which, upon their roots and with their foliage, rise frail stalks carrying, against all reason, persons seated. From these stalks spring flowers out of which come half-length figurines with whimsical heads."

The body of the building at the back advanced on each side of a court and garden, through two lateral wings, high and ornate. The sort of court that these three facades inclosed was covered with a roof.

In theaters more ancient than that of Orange (for example, in the Greek ones) the wings of the building did not advance as far as to the footlights, as we would say to-day. This court was closed by a grille, and with its back against this was placed a statue of Apollo Aguieus, the god of the street, and it was the street indeed that passed in the foreground of the stage. It is in the street that Antigone calls Ismene to the first act, in order to impart his secret to her without witnesses. The curtain was lowered into the basement through an opening that bordered the grille. As for the vacant spaces left at the sides and in front of the wings, they were occupied by the periactes, huge prisms mounted upon a pivot inserted in the floor, and carrying three different scenes upon their three faces, so that a simple turn changed an entire panel of the stage setting.

It is a question as to whether the back wall with its colonnades and statues was the permanent decoration for all spectacles. Mr. Heuzey has rightly remarked that this imposing architectural decoration has the appearance of being designed for the general harmony of the edifice rather than for scenic illusion. So some have defended the hypothesis of Piranese, which supposes movable frames brought in front of the facade of the palace for each drama. It is very certain that in Greece, in certain cases, the palace was hidden by a high semicircular frame called a hemicyclion, upon the internal surface of which was represented a landscape when it was required, that is to say, in comedy; for all tragedies took place in front of the palace. Mr. Saint Saens asserts, somewhat hastily, that at Orange the palace was hidden by a movable scene when playing was done. Such a stage setting would have been a massacre. Why should this splendid facade have been concealed by a pasteboard frame? It is answered: Because the actors would have seemed like pygmies in front of this ninety foot structure. It is forgotten that the actor's costume increased his height and girth; and even without that the inconvenience would have been slight. On the contrary, there is every reason to believe that he played in front of this palace of marble. In the first place, the stage was already so narrow that it could not be more so. The personages of the Greek tragedy did not group themselves rearward, but side by side. Each scene was a bass relief. The stage seemed to reflect the friezes of the Parthenon. And especially was this palace admirably arranged for the entrances and exits of the dramatis personæ, as we shall see.

All the ancient theaters imitated the Greek theater of Dionysos upon the Acropolis. There the spectator, from his seat above the stage palace, perceived the white houses of Athens to his right and the plains of Attica to his left. So, to him, the actors who entered from the Athens side were natives, while those who came in at the other were strangers, travelers, or messengers.

We find this arrangement again at Orange. Look at the stage. It has five doors, each of which has its special attribute. In the center is the pyli basiliki, the royal door. The king never entered through any other, and any person who entered through it was the king.

To the left is the gynecee. From this came the women, the queen or the princesses. To the right is the door of the apartments of the hosts.

There remain the two doors of the wings. That to the right allowed of the passage of the people of the country, while that to the left was for foreigners upon their arrival. In this way, the Greek or Roman spectator knew at once, by the sole fact of his entrance, what sort of a person he had under his eyes.

We can here, for want of space, do no more than touch upon these questions of scenery, costumes, stage setting, and machinery. The machines of the ancient theater were wonderful. Twelve oceanides at once (in Prometheus Vinctus) were moved through the air in a winged car by means of a crane, and traps (anapies-mata) perforated the skillfully arranged floor. There was a special trap for the shades of the infernal regions, and it was called Charon's hole.

The dressing rooms were beneath and back of the stage. It was there that the actors dressed with an absence of the comfortable that sufficed the servile histrions of antiquity, but which would not much please our modern artists. Less delicate were those solid jolly fellows of bygone days, who played Œdipus with their head inclosed in a two-faced mask (the right side smiling and the left depicting terror) for sudden changes of feeling, the body and arms padded with multiple cushions, the somation for the back, the progastridion upon the abdomen, and the prosternidion upon the chest—the whole concealed beneath embroideries and the golden brocades of the enduma or of the epiblema—royal mantles.

Among the machines, the bronteion made the thunder, the ceraunoscopeion brought the deus ex machina in upon a cloud, and the encycleme brought into the sight of the spectators, in a sort of tableau vivant, a scene that was supposed to occur in the interior of the palace. Supposing it was too dark in the building to allow distant spectators to see anything, the large door opened, and the floor was rolled from the encycleme through the embrasure, so that the group was brought into full daylight as if the entire chamber had advanced to the sun. This might have been done with Antigone for carrying the corpse of Eurydice out of the palace.

Here, in a few hasty lines, we have the external aspect and material organization presented by the ancient theater, which was so different from ours. The fetes of Orange are going to give a vague idea of it. The same sun that shone upon the Gallo-Roman matinees is going to shine anew upon the crowded benches and upon the peplums of the old men of Thebes. The only change will be the black frock coats of the spectators and the diminished stature of the persons upon the proscenium.

The enthusiasm will be no less, and, as for the æsthetic taste of the population, were it doubted that that had become singularly refined and improved since the emperors, it would suffice to reflect that the neighboring circus, the theater of the combat of beasts, has disappeared without any one thinking of regretting it, while the Theater of Orange has risen from its ruins in order to afford a few thousand curiosity seekers and literati the rare sensation of an archæological dramatic fete.—L'Illustration.

PLAYING PELOTA.

IN his erudite work on "La Pelota y los Pelotaris," Senor Antonio Pena y Goni observes with some humor that Adam and Eve were the first players of pelota and that Paradise was the first scene of the game. In other words, the origin of the national ball game of Spain it is impossible to state with accuracy. Kinship can be traced between it and the old jeu de paume of France. The prototype can be partially recognized in that game of pallone of which, as students of Italian history will remember, the dissolute Piero de Medici was so inordinately fond. It has points in common with the English game of fives.

The pelotaris wear in the fronton light trousers and shirts, two of the players wearing white, the other two blue shirts or brown, as the case may be. All four wear the soft, graceful cap which formerly inevitably proclaimed the Basque until it was introduced in Madrid and elsewhere in Castile and worn by all the common people. The game is simple and easily described, if I omit the elaborate terminology used by the expert to classify this or that kind of blow. The court is about thirty feet wide and nearly two hundred feet long. The two end walls and the side wall on the left, all about forty feet high, are reserved for the players. Facing them, on the right, are the seats for the spectators. The ball is excessively hard and rebounds with the elasticity of rubber. It is caught and thrown with a long, hard, scoop-like racket woven of cane and provided at the thick end with a tightly fastened glove which is fitted to the right hand of the player. He uses it to hurl the ball against the wall, not by an uplifting of the arm and a movement of the palm of the hand outward from above the level of his

shoulders, as one would cast a lance. Neither does he often use it with the motion employed in croquet. On the contrary, in a very curious manner, he turns his back upon the wall at which he is aiming, extends his right arm, twists it so that the thumb is underneath, and in that puzzling position contrives to put terrific force into his throw.

Under the exercise of the game the muscles acquire, says Senor Pena y Goni, the character of steel. So powerful are the movements of these men that when the ball rebounded from the wall the other day and struck one of the players on the shoulder, he had to abandon the game for ten minutes and be rubbed with oil. The object of the pelotari is to knock the ball against the wall in such a way that his antagonists will be unable to catch and return it to the wall. If he succeeds in this, he scores. If he does not, if instead the other side catches the ball, throws it back, and he or his partner misses it on the rebound, then the opposing players score. There is a strip of iron running across the wall at the upper end of the court, the end at which the ball is always aimed. This strip, which is affixed at a height of about four feet from the ground, is matched by another thirty feet higher up. Whichever side knocks the ball below the lower strip, above the higher, or against either of them, loses that inning. The game is usually for fifty points, each inning counting one, and, briskly played, it lasts from five to seven in the afternoon. It is extraordinarily fascinating. The ball is kept in motion sometimes for five minutes, or even longer, at a stretch—a considerable time when the great length of the court is remembered. It may be struck either while in mid-air or on the first rebound from the pavement. The lithe players fly as though on wings from point to point, sometimes nearly the whole length of the court. They catch the ball with the beak-like point of the racket when it is shooting over the heads of the people in the first rows of chairs, and they send it back to the home wall with a strength and precision quite remarkable. The people flock to the frontons unceasingly, and they gamble on the results with a passion that leaves the betting scenes of the races far in the rear.—New York Tribune.

[From the Pharmaceutical Era.]

HOW SHALL YOUNG MEN BE EDUCATED IN APPLIED CHEMISTRY?

By Peter T. Austen, Ph.D., F.C.S., Professor of Chemistry in the Brooklyn Polytechnic Institute.

There have of late appeared so many articles on the training of chemists* that I respond with some hesitation to the request of the editor of the Era for my views on this subject, because I feel that I may not have much to add to what has already been so well said by others. But as one who for a number of years has been preparing young men for active work in chemistry, and as one who has also been closely connected in various capacities with numerous manufacturing establishments, I may be able to emphasize some of the points already made, and perhaps also suggest others which my experience may lead me to consider worthy of attention.

Chemistry is probably the most fundamental of all sciences, since it concerns itself directly with the study of the composition and changes in identity of matter. Hence it is not possible to predict what path the chemical student will pursue when he becomes independent and able to choose for himself, or what opportunities he may grasp if they are presented to him. Sooner or later every manufacture calls for chemical knowledge, because in every manufacture the steps are more or less chemical changes, and the composition of the articles handled must be known. In the past this was not appreciated, but at present it is rapidly becoming recognized, and indeed in branches of manufacturing which are far from appearing chemical to the ordinary observer. A moment's reflection will, however, enable the educated reader to understand that manufacturing is but a series of material changes. Many of these may be mere changes of state, physical changes, effected by mechanical appliances, but even in these the composition of the substances may play an important part, and, at best, no clean-cut division between physical and chemical phenomena is possible.

The day of the ignorant man, of the rule-of-thumb man, of the so-called "practical man," has closed. Such men must needs be non-progressive. They can carry out what they have been taught, but they cannot originate, neither do they seem to be able to learn anything after a certain time. They are also apt to be as overbearing and disagreeable as they are ignorant and inefficient.

The men who are now eagerly sought by large manufacturing concerns are those who are as highly educated as the complicated machinery of education can make them. Who can bring into action the greatest concentration of human knowledge concerning the particular subjects at which they are put to work, and who can devise new methods, invent new processes, obtain new products and discover new facts. Who, if I might so express it, can think chemically and speak mechanically, and yet withal must be of the highest moral character, honest to a fault, and able to acquire the art of business, cultivating that element of tact which enables a man to control others and yet hold them as friends, and last, but not least, that disposition of mind which impels a man to seek his reward in the character of his work rather than in personal glory; whose happiness depends on the success of his work, on tangible results, rather than on applause or on mere learning, versatility, self-approbation, or any other of the effervescent phenomena which some lads exhibit to the men who are toiling wearily, and often none too competently, to carry on large industries, and who are seeking far more eagerly than is generally supposed for real scientific assistance. Young men who make the interests of their employers their own, and, glad as they may be to get their sip of the sweet, are not afraid to take the bitter without a grimace when it comes, as it always will, sooner or later, and yet withal have the independence to resist in a frank and manly way any treatment, open or covert, which may savor of injustice or oppression.

The strength and power of such men are never underestimated or unappreciated by business men, say what one will about the soullessness of large corporations or the heartlessness of mercantile business; for the maintenance and development of a large business call for educated brains at the head of each and every department, and no business can afford to lose brains that have been educated in its employ and which are actively working to advance its interests.

I have dwelt on this subject rather fully, because I wish to make it clear that the young chemist is liable to be an indeterminate quantity. He may enter an analytical laboratory and he may stay there all his life, every day making analyses; he may rise to own it; he may occupy himself with the processes of manufacturing and leave the mechanical working out to others or do it himself; he may step out into the works and superintend the processes, improve them, invent new ones, get up new products and what not; he may rise to be superintendent of the whole works; if he has the peculiar ability he may go on the road and sell the goods, and as he knows all there is to be known about the articles he handles and those handled by others, he makes a salesman par excellence; understanding better than any one else the facts and reasons involved in the manufacture, and being chemically familiar with the articles, he may be called to take charge of an agency, or may be put to study the market to size up rivals; he may be made a director, or, for the matter of that, may rise to be president of the company; he may in time start a manufacture of his own; he may study law and become a distinguished patent expert; he may teach; he may become a physician or biologist; he may become a successful farmer; he may become the chemical adviser of manufacturers, whose interests are not of such a chemical nature that they can afford to employ the whole time of a chemist, but whose problems are none the less difficult, and hence require the assistance of a skilled, learned and experienced chemist. I might still prolong this list and yet not know when to stop, for all of these cases, and many more besides, I know from actual acquaintance.

It might be inferred from the above that since the future of a chemical student is so uncertain, it would be impossible to lay out a course of study that should fit a man for all of them. In the strict sense this is true, but a course of study is not intended to do more than to ground a student thoroughly in the principles and practice of the science in such a way and to such an extent that he may be able to take up any application of the science he may choose and follow it up by independent study and experimentation. Education bears a relation to a young man that is somewhat akin to that between the powder and the gun. We may charge him with facts as we do a gun with powder; we may show him how to get more, how to hold the gun, how to aim, but he must provide the gun, the ball and the cap. He may have all these and still not be able to hit the mark; he may have a big charge of powder, but a small ball; or his gun may knock him down by its recoil, or go off at the wrong time, or perhaps at the wrong end; or perhaps he has all but the cap, and another must provide it, and that is the saddest case of all. But, fortunately, experience proves that the average young man, who is properly and well educated, and who applies himself faithfully to his work, does not fail, but advances steadily.

It would not be courteous for me to discuss or criticise the various chemical courses of our leading educational institutions, but I may point out the kind and nature of a course in chemistry which, so far as my experience indicates, will educate men who are best able to fill the demands made by this country; and I might add here that in some respects this country calls for somewhat different courses of study than those of Germany, one cause, among others, being the wide difference which exists between the school education of Germany and of the United States.

The student must be thoroughly practiced in English. This may appear an unnecessary statement, but any one who has to deal with young men knows how frequently they are deficient in the ability to write and speak English well, or even to spell correctly. I do not wish to decry other studies, nor to involve myself in a discussion of the value of a classical education, but I do wish to emphasize most strongly the necessity for a thorough education in our own language. I know of but one way to accomplish this, and that is by long and continual practice. Not only should the essays of the student be corrected, but his daily writing, analytical reports, lecture notes, etc., should be corrected not only as to facts and accuracy, but as to spelling and style as well. The ability to speak easily, clearly, briefly, forcibly, with good articulation, and to the point, not only to another, but before an audience, should be most assiduously practiced.

The ability to read German is absolutely necessary to the chemist. Most of our chemical literature is in German; indeed, most of the progress in chemical science is now in Germany. To learn to read a language is far easier than to learn to speak it; for in the written language most of the difficulties are already overcome. To read, one has but to learn the idiomatic differences between the language and English, and become familiar with the vocabulary. The idiomatic differences are not so numerous as to offer great difficulties. They are all in print before us, and, in the case of German, a small grammar, intended only for assistance in translation, with patient use of the dictionary, enables the average student to read scientific German with facility in a surprisingly short time, and opens to him the immense field of German scientific literature. To learn to speak and write German with any degree of correctness is a much greater task. The construction in a foreign language is always difficult, and requires great study and practice to accomplish much. While the chemical student may learn to write and speak German if he has the time to devote to it, the education in sight reading of scientific German is absolutely necessary, and is not difficult. Unless he has this ability he can hardly hope to become an independent chemical student or worker. French is not so absolutely necessary as German, but still of great importance. It is an easy language to learn to read, and the chemical student should make himself an adept at sight reading of it.

It would extend this article beyond its legitimate limits if I should attempt to discuss all the studies of a chemical course; suffice it to say that a thorough grounding in history, the elements of law, political economy, mathematics, metaphysics, logic, ethics and literature should be effected. The specialist is not made by picking out a few studies, but by concentrating as he advances; he advances from the general to the particular. The minds of the great specialists are like burning glasses, which collect a great amount of light and heat and focus them on a given point. The development of a scientific education should be like the building of a pyramid, which rises from a broad and ample foundation to an apex, from which an immense field of observation is commanded.

It is needless to say that a thorough study should be made of physics, and especially of electricity, which every day is finding new applications in chemistry, and offers tempting fields for research to the chemist, and for technical applications as well.* Heat, on account of its vital importance in chemical changes, should receive particular attention.

With this introduction, let me consider the course in chemical instruction which I consider best adapted to develop independent young chemists.

In many institutions of learning, the instruction in chemistry is too much confined to analysis. Many young men are graduated who, while fair analysts, do not seem to be capable of anything else. They are not familiar with experimental chemistry, or with manipulations, apparatus and methods not used in analysis; they are unable to prepare pure substances, and their knowledge of mechanical methods of handling substances on a large scale amounts to practically nothing. Such men are naturally handicapped when entering a works, for methods of manufacturing do not resemble methods of analysis, and the difficulties which assail one on all sides are quite different from those met in analytical work. But in the study of experimental chemistry and in the preparation of pure substances the student at once comes in touch with the manufacturer in a way that one trained only in analytical chemistry never can.

The course in chemistry should, therefore, begin in the laboratory, and with a thorough and elaborate drill in experimental chemistry. The principal elements and their compounds, properties and chemical conduct should be studied experimentally. The knowledge thus gained is invaluable. Indeed, such a course of study should be a part of any education; for a man cannot now be considered educated who is not familiar with the properties and behavior of matter. Much of the success of any man, and I might say, also, much of his happiness, will depend on his mastery over matter, and his ability to combat it when it becomes inimical to him. Only a knowledge of chemistry and physics (physical science) acquired by personally conducted experiments can give him this. No amount of reading books, or even listening to lectures or witnessing experiments made by others, can give him the real knowledge, and the full appreciation of the things about him and their influence upon his walfare. Actual and practical knowledge puts under a man's control a great power, which he can utilize for his own good and safety. Failure, distress, and poverty are too often synonymous not merely with ignorance, but with ignorance of physical science. If a man does not master the things about him, they may easily master him.

During the course in experimental chemistry there should be given a thorough lecture course in chemistry, illustrated elaborately with experiments, and accompanied with continual quizzing on the lectures. All the experiments should be sketched and described, and the notebooks should be frequently criticised by the instructor. After experimental chemistry is completed, a course in blowpipe analysis should be given, after which should follow qualitative analysis and then quantitative analysis. Apart from its scientific side, quantitative analysis requires a large amount of practice to develop a skillful and exact manipulation. While some students are quicker than others, there is no short cut to accuracy in this subject. In teaching quantitative analysis, care should be taken to keep abreast of the times as to methods. The instructor should be in touch with the laboratories of large works and take advantage of their methods or improve them. Men working on only a few forms of analysis, as in the case of steel, fertilizers, etc., evolve methods which are amazingly rapid, yet are also accurate. There is no particular call for secrecy about these methods, and any instructor can acquire them. As a rule, it is to the interest of manufacturers to have men educated in methods which have been adopted in the trade. It is, however, not uncommon to find methods of analysis taught in colleges which are antiquated, and could not be used in practice. Along with quantitative analysis, assaying and also mineralogy should be taught.

Toward the end of the instruction in quantitative analysis instruction should be given in the preparation of pure substances. The importance of this branch of the chemist's education cannot be overestimated. Not only should the purity of the preparation be called for, but its yield must be determined and reported, and the side products and wastes should be examined. The results at first obtained are usually humiliating to the student and disappointing to the instructor, but as the manipulation of the embryonic manufacturer increases, results soon begin to appear which encourage and incite to renewed efforts. No chemist can hope to become a successful investigator, either in pure or applied chemistry, who is not skillful in the preparation of pure substances. The element of practicality soon begins to show itself as the student gets increasing yields without deterioration of purity.

During the course a carefully considered set of lectures should be delivered on technical chemistry, and special attention should be devoted to the relationship which exists between manufactures. A well stocked technical collection should be at the use of the students, and visits to representative manu-

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* Note.—"Relation of Teaching to Research in Chemistry."—Stone, J. Am. Chem. Soc., xv., 665.
"Education of Industrial Chemists."—Lange, ibid., xv., 481.
"Education of Industrial Chemists."—Pemberton, ibid., xv., 627.
"How Chemistry is Best Taught."—Mabery, ibid., xv., 463.
"Education."—Bayer, S. of M. Quart., xiv., 248.
"Organization and Management of Chemical Works."—Carey, J. Soc. Chem. Ind., xii., 991.

* Note the sudden development of the idea of electrical power in works, doing away with long steam lines, shafts, belting, etc., and reducing the coal consumption in some cases one-quarter to one-third, and the end is not yet.

factories should be made. A course of instruction should also be given in what is now termed "Chemical Engineering." This is a difficult subject to teach, and but few in this country are really fitted to undertake it. There appear to be great possibilities in classification in it, and an excellent opportunity for a good text book.* The various operations of manufacturing chemistry should be considered in detail, and grouped so as to be as independent as possible of particular substances, but rather appear as related to groups of substances of allied properties. Thus, in precipitation, solution, evaporation, stirring, heating and filtration, the various mechanical devices should be grouped and their adaptations to substances of allied properties explained.

The steam plant, pumps, vacuum and pressure apparatus should be lucidly described, so that the initial types and their manifold variations and adaptations may be understood. In this course of instruction, however, the inclination should be toward the adaptation of mechanics to chemical treatment rather than toward mechanical engineering. One reason for this is that it may easily make the course too long to fit in our educational institutions, and another is that the technical chemist can always count on the assistance of mechanical engineers for minor details and adjustments in any works of magnitude with which he is connected. Almost all the mechanical devices for handling chemical substances on a large scale will be found on study to consist of a simple principle which has been modified to adapt it to the properties of the particular article. The experienced instructor is, therefore, able to treat the subject of chemical engineering with some degree of pedagogical success, and ground his students in the principles, yet still indicate many possible variations, adaptations, and evolutions for which the nature of the substance to be handled or the exigencies of manufacturing may call. Thus a stirrer, consisting of an upright shaft resting in a seat, and provided with flat wings attached at right angles, is a simple mechanical device; but, depending on the specific gravity, the viscosity, the temperature, the composition, etc., of the liquid to be stirred, many modifications will call for study. Thus the wings may be set at a bevel; secondary immovable or movable wings may be attached, the shape of the vat may be varied, the stirrer may run on a seat, or it may be hung free; it may be lifted out or not; it may be of wood or metal, or both; its motion may be simple or compound. It is evident, however, that a study of stirring machinery will leave a much clearer idea in the student's mind, and enable him to make a better choice of stirring machinery when called on to draw up specifications which include this form of mechanical treatment than if he had studied stirrers only as he met them in the various branches of manufacturing. In this latter method of study, which is the usual one, no clear, systematic or co-ordinated knowledge of stirrers as a class of mechanical devices is obtained, nor is any exact knowledge obtained of the modifications of a mechanical type to adapt it or develop it to suit varying conditions. Without this clear insight into the matter, the student is not well able to evolve new forms of stirrers himself, and hence is unable to attain the most perfect relation between the substances and their mechanical treatment under the particular conditions of the works. This always tells against him in the long run. He will have to depend largely on the swarms of salesmen who pursue him unceasingly, each of whom is positive that his device surpasses all others, but who is rarely willing to guarantee his apparatus or to allow a trial of it, and least of all on new articles. In this way he does not always get the best appliance, but that of the most skillful and adroit salesman. Again, so separately and exclusively are manufactures frequently carried on that devices used by one manufacturer, and which are unknown to a manufacturer of articles of an entirely different nature, might be of great value to the latter, since his products, although quite different, still possess properties which in some points call for almost the same mechanical treatment. In this case, again, the study of the mechanical device as a principle, and its modifications to adapt it to different conditions, is manifestly of great value to the young technical chemist. He is not only able to secure that adaptation which best suits his case, but, understanding clearly the relation between the adaptation and the principle, he is in a position to evolve or invent himself an adaptation better than any other.

The above is true for most of the mechanical devices used in chemical manufacturing. For instance, in the case of boilers, the young technologist may fairly go insane when besieged by boiler agents, and, as a rule, he has very little idea what is called for. He may put in a boiler capable of quick firing and high pressure, when neither is of much importance to him, and when a heavy draught of steam, rather than power, is demanded. A study of boilers and their different types with a view to the various demands made upon them in chemical manufacturing, aside from maintenance of power, will enable him to choose what is best adapted to his particular wants. The course in chemical engineering is best preceded by a course in mechanics, but not so full a one as is given in a course in mechanical engineering.

I have dilated on this branch of the education of chemists because I have had not only to educate young chemists, but to employ them in manufacturing. The gaps in their education which might be referred to inexperience by the man of business are not so easily overlooked by one who is also an instructor, for much of this ignorance, which, I might add, may easily cost the employer an amount as great or greater than the cost of the young man's education, could have been overcome during his education. Even such a matter as wooden vats is a constant source of vexation to the young chemist. Given a certain volume of liquid to handle, shall the vats be made tall and narrow, or low and wide? Shall there be a few large ones or several smaller ones? How much space shall be allowed under them? How near together shall they be? What accidents are to be provided against? There are certain principles underlying these simple matters which an experienced technical chemist can easily impart to his students, and vexatious errors and serious losses may be avoided by them.

* Hoyer's Mechanische Technologie is the only one of note.

The practice in the preparation of pure substances makes an admirable introduction to practice in the use of typical forms of technical apparatus on a small scale, and any time spent on this will be valuable indeed to the student, no matter whether he intends to devote himself to applied or pure chemistry. Practice in the use of miniature technical apparatus is, however, a branch of work that is best taken up as a post-graduate. During the last years a great progress has been made in applying technical apparatus to laboratory work, and many of these forms of apparatus are as attractive and exciting to chemical workers as bits of transparent carbon crystals are to our betters. Each new catalogue from Germany puts one into a fever. Until a chemical course has rooms provided with these miniature imitations of technical apparatus it can hardly be called a course in chemical engineering, any more than a course in mechanical engineering could be so called if lathes, planes, drills, etc., were not provided for the use of students. Let me draw attention to some of the details of this department of technical chemistry. The vats of manufacturing are represented by wash tubs, headless barrels, agate ironware and stoneware. Short pieces of lumber enable us to elevate them in tiers or in any other relation. Brass and copper pipe with rubber hose connections and copper wire bindings lead the liquids where we wish. A steam pipe supplies dry steam throughout the whole laboratory. The floor is bricked, inclined and channeled. It will stand heat or liquids. A kit of ordinary tools is at hand, saws, planes, grindstone, etc., and also a small forge. Shafting is handy over all, and is run by electric motors. Electric power wires can be had anywhere, and thus power can be used independent of shafting. Small bronze pumps driven by independent motors can be placed where they may be needed. A plentiful supply of several way cocks is on hand, and among the miniature pieces of technical apparatus are steam kettles, filter presses, pressure digestors provided with stirrers, evaporators, vacuum pans, filter trays, distillation and column apparatus, centrifugals and gas blast furnaces, large and small balances and scales, and gas compressors. Vacuum and pressure cocks are in convenient places for attachment. I might go on with the list, but this will be enough to indicate what the department should be. Students may work alone, or in groups, in case of more complicated operations. It is needless to dilate on the value to the student of the work done in this department.

The chemical course should include a most thorough drill, not only in stoichiometry, the mathematics of chemistry, but also in mensural calculations. The volumes of tubs, vats, barrels, pans and what not must be readily calculable by the technologist. The more familiar a man is with higher mathematics, the better; no time spent on it can be lost, but dexterity in arithmetic and in simple and compound proportions is of great importance, although I fear it is often overlooked or underrated in our chemical courses. Dexterity in calculating volumes and weights of substances into gallons and pounds is called for all the time. Hence this must not be overlooked when teaching the metric system, useful as the latter is. I have known young men who have been well educated, but who have been much perplexed at the calculation of problems requiring more familiarity with an engineer's handbook than great erudition, and which are constantly recurring in chemical practice; as, for instance, How many inches deep must a cone-shaped kettle with a round bottom be filled to contain a given number of pounds of a certain liquid of a certain specific gravity?

Throughout the course a thorough drill in draughting should be given, and especially in free-hand sketching. The ability to draw will be invaluable to the technical chemist. Especially is it important to be able to illustrate his ideas by rapid sketches, for these save endless trouble with the mechanics with whom he has to deal.

Some instruction should also be given in the rudiments of building and strength of materials, particularly as related to factory buildings.

There are some other subjects in which young technical chemists are inclined to be wofully deficient, but which are capable of being included in the chemical course, and even if not taught as fully as they might be, ought to be explained to the student sufficiently to enable him to go on with the subjects himself, and also to know something about their literature. I allude to the business side of industrial chemistry, including double entry bookkeeping, computations of cost of materials and manufacturing costs, distribution of costs, estimation of profits, charging off for wear and tear, rating, organization, nature, characteristics and management of labor, factory organization, emergencies, and the common principles of business and patent law.

It will always be of great advantage to the student to spend a year as post-graduate and devote his time to higher chemical study undistracted by other work. During this time he should carry on under competent instruction some purely scientific original investigation, and not only acquaint himself with the methods of research, but also become familiar with the ways of reading on chemical subjects, the indexes and keys to chemical literature, the great journals and the other details of literary chemistry. In carrying on an original investigation, it would be, perhaps, more to the benefit of the student if he were also practiced in producing known substances by new methods. Much of our original investigation, especially that of youthful savants, consists in making new substances by well known methods. These new substances are valuable in many ways in scientific classification, and are dear to their discoverers, but the other line of work is fully as valuable to the student, viz., finding new ways to make known substances. When experienced in both forms of procedure he is more likely to be successful in achieving what does not often fall to the lot of the student to do, i. e., make new substances by new methods. In manufacturing, new processes are as important as new products; hence the young investigator should be practiced in both these kinds of work. It must never be forgotten that in technical chemistry the demonstration of chemical facts is made practical on a large scale with but little loss and at a low cost. It is evident, I think, from this that the study of pure chemistry and the education in purely scientific research, by which I mean the ability to discover new chemical facts, must not be overlooked or slighted, else the technical chemist may not have material to work on and may come to resemble a hen that sits on glass eggs.

In the above it has not been my attempt to describe in detail a complete chemical course, but only to indicate what appear to be some of the more important subjects of such a curriculum, that the student may be guided to some extent in his choice of a course. As in all other matters in this life, the element of individuality enters most vitally into education, and the student will do well to choose men rather than institutions, as is the custom in Germany. The most important element in the student's life is personal contact with powerful and highly educated men, who incite him to work, enthuse him and develop in him the ability to think for himself and originate, to use knowledge to produce new knowledge. In the intense excitement which accompanies original work the acquisition of knowledge becomes mere play, and students soon learn how to ransack libraries and mine their own information. In actual life men do not read and study to prepare for recitations or examinations, but to assist them in the production of new ideas or new facts, i. e., new knowledge. Knowledge plays the part of a fertilizer to the active, growing, producing mind. Any other relation is liable to produce mere pedants, men who are filled with knowledge like water-soaked sponges, and who emit it, like sponges, in the same condition in which it was absorbed. A good encyclopedia is worth tons of this deliquescent humanity.

CHEMICAL PERFUMES.

ALMOST all the natural perfumes are of vegetable origin, and are derived from the treatment of flowers and fruits. In this way are obtained the aromatic essential oils of rose, mint, anise, santal, thyme, cloves, etc., and the perfumes of the violet, iris and jasmin. Musk is the only important perfume that is of animal origin.

For a long time now, however, the odor of fruits has been imitated with the aldehydes and ethers of fatty acids, such as the acetates, valerianates, benzoates, salicylates and butyrates of methyl, ethyl and amyl, which, mixed in definite proportions, recall the odor of strawberries, raspberries, apples, pears, etc. The following are two examples of such mixtures:

PERFUME OF THE PINEAPPLE.

	Grammes.
Chloroform	10
Aldehyde	10
Butyrate of ethyl	50
Butyrate of amyl	100
Glycerine	30
Alcohol, 100° (liter)	1

PERFUME OF THE APPLE.

Chloroform	10
Nitric ether	10
Aldehyde	20
Acetate of ethyl	10
Valerianate of amyl	100
Glycerine	40
Alcohol, 100° (liter)	1

The aroma of rum and cognac and the bouquet of wines have also been reproduced artificially. We shall not dwell upon the danger that accompanies the use of these products in a large quantity when they are mixed with beverages and alimentary substances. We shall occupy ourselves here more particularly either with products like those which we find in nature, such as vanilline, or with perfumes, such as musk and the odor of violet, which are designed not for alimentation, but for perfumery properly so called.

Among the aromatic products employed as perfumes we may first mention methylsalicylic ether, which reproduces the oil of wintergreen. The oil of bitter almonds, too, has been frequently replaced by nitrobenzine. Nitrobenzine, as regards composition, is absolutely different from the oil of bitter almonds, but it resembles it in odor. Benzaldehyde, likewise, has replaced the oil of bitter almonds in certain cases.

Such substances possess but a secondary importance; but vanilline, on the contrary, which reproduces the odoriferous principle of the vanilla bean, is an object of an extensive and very prosperous manufacture. The first process that gave rise to it was elaborated in 1874 by Messrs. Tiemann and Haarmann. In studying coniferine, these scientists found that it was formed of a glucoside which under the influence of a special ferment (emulsine) split up into glucose and coniferic acid. This latter, through oxidation, gives vanilline. The coniferine itself, oxidized with a mixture of sulphuric acid and bichromate, furnishes vanilline. It was by this process that it was first manufactured. The method of purification was very simple. Like aldehyde, vanilla possesses the property of forming an insoluble bisulphite combination, which was separated from the mass and afterward decomposed.

Chemically, vanilline is methylprotocatechuic aldehyde.

The arrangement of the benzenic nucleus is of importance, since isouanilline, which is constituted by exactly the same groupings, but differently placed, has no odor. After the formula of vanilline became known, an endeavor was made to employ the neighboring bodies, to add the groupings that were wanting, and to properly place them with respect to each other. A host of methods was proposed to this effect, in making use of eugenol (De Laire and Tiemann), which was oxidized by permanganate; of eugenol and bromide of methylene (De Boissieu); and of guaicol and pyrocatechine (Tiemann and Reimer). Vanilline is even found in certain natural products, such as the benzoin of Siam, crude beet sugar, asafetida, and opium. A certain number of these processes is employed industrially.

Piperonal or heliotropine is closely connected with vanilline. It is, in fact, the methylenic ether of protocatechuic aldehyde. In order to prepare it, piperic acid is oxidized by permanganate, but it can also be obtained by means of safrol. It is found in the oils of sassafras and shikimal, and can also be obtained from the oil of camphor. Coumarine is the anhydride of ortho oxycinnamic acid. It has been obtained synthetically by Perkin by causing acetic anhydride to react upon the sodium salt of salicylic adehyde. It is

especially extracted from natural products, such as the tonka bean and the "vanilla plant" (Liatris odoratissima) of the United States.

Spirit of turpentine has likewise yielded a perfume, the terpinol of De Laire. To this effect one can either dehydrate terpene or treat spirit of turpentine directly. This perfume is known under the name of lily of the valley or lilac.

We now come to the two most recent discoveries, viz., the perfume of musk and that of the violet. Natural musk is the product of a secretion of the musk deer, a ruminant mammal that inhabits certain regions of Asia. The perfume is found in a sack which usually contains from 14 to 20 grammes of it. It is also found, but in much smaller or even minimum quantity, in other animals, such as the civet, the musk rat, the badger, and the marten. Certain plants, too, often possess the odor of musk. This product is of the highest importance, since it is the base of all artificial perfumes, which sometimes contain considerable quantities of it.

The first process of preparation of a product having the odor of musk was discovered by Messrs. Shaafer and Haffeld, who heated a mixture of dimethyl benzine, isobutylic alcohol, and chloride of zinc, which they afterward broke up and nitrated. The truly industrial discovery of an artificial musk dates back to 1889, and was made by Mr. Baur, on the occasion of some researches upon the oil of resin.

In order to prepare the Baur musk chloride of isobutyl is made to react upon toluene (methyl benzine) in the presence of chloride of aluminum. We thus obtain isobutyl toluene, which, under the influence of nitric acid, is converted into trinitroisobutyl toluene, which is the somewhat cumbersome chemical name of commercial musk.

There exists, theoretically, a host of analogues and homologues of this musk. A certain number of them have been prepared from xylene, cymene, and the diphenyl and xylyl methanes. A large number of such products possess the characteristic odor of musk.

A no less important discovery is that made a year ago by Mr. Tiemann, who reproduced synthetically the perfume of the violet (called ionone) after a series of researches of the greatest interest, from a scientific standpoint.

In order to prepare this perfume we start from citral, which is itself derived from the oil of lemon, or from the oxidation of the alcohols of the formula $C_{10}H_{18}O$ that we find in certain essential oils; geraniol, linaleol, aurantiol, and lavendol. The citral is shaken with acetone and barytes, and pseudo ionone is thus formed. This body is odorless, and in order to render it odorous it is necessary to convert it into ionone, a product which is very closely related, but which is cyclic, while the pseudo derivative is of the open chain series. A long series of similar products can be made with other acetones, and these have been studied with the greatest care by Messrs. De Laire and Tiemann.

Messrs. Tiemann and Kruger, on treating orris root with appropriate solutions, have separated various products and, among others, irone, which is the odorous principle of this root, and it was in the wake of these experiments that the synthesis of ionone was made, these two bodies being, in fact, isomerous, and consequently very closely related.—Le Génie Civil.

AN OLD BUT FLOURISHING BLUNDER IN MEDICAL CHEMISTRY.

By Chas. W. Folkard.

"Lithic urate is more soluble than any other of these salts [the urates]. Hence lithia water is occasionally prescribed to gouty patients and to others who suffer from a superabundance of uric acid."

The above is an extract from p. 773, Part III., of Miller's "Elements of Chemistry," 4th edition, published in 1869, and there is sufficient semblance to truth in it to mislead those who are able to devote but a few months to the study of chemistry, as is the case with the majority of medical students.

Although the paragraph quoted was omitted in the new edition published in 1880, it would seem that no attention was called to the subject, for sufferers from a too abundant secretion of uric acid have been treated up to the present time on an erroneous assumption, proceeding from the "little knowledge" which is admittedly so dangerous, and which is also doubtless responsible for the practice of exhibiting chlorate of potash in cases of blood poisoning, "to oxidize and destroy the poison in the blood," whereas every chemist is aware that in an alkali solution like the blood the chlorate of potassium is practically as stable and inert as the chloride, or as common salt.

In these remarks the writer disclaims the idea of censuring the members of the medical profession, because these are chemical subjects, and if blame be due anywhere, it must undoubtedly fall upon chemists for neglecting to point out to the members of an allied profession the absurdities involved in these two cases.

There is, however, one great consolation for the uric acid and pyæmia patients who have been wrongly treated, viz., that both lithia water and chlorate of potash are (so far as we know) harmless, quite unlike the copious blood letting and salivation treatments of a bygone age.

At the same time it must be remembered that the use of valueless "remedies," however harmless in themselves, hinders or altogether prevents the search for real and rational ones. The sooner, therefore, attention is drawn to them the better for the patients, even should there be nothing to propose in lieu of those discarded.

Although the absurdity of the lithia water "bull" merely requires to be mentioned to a trained chemist to be at once recognized, it may be as well to give a few details.

In the first place, the substitution of lithium for sodium in the animal economy would probably be by no means an unimportant change. Physiologists have found that the substitution of the blood of one animal for that of another is possible in the case of allied species, but in that of animals belonging to different genera the change may be followed by immediate death. In all probability, therefore, it would be a very risky proceeding to convert the albuminate of sodium in human blood into albuminate of lithium, even if it were possible. Fortunately for the patient, however, this is as likely to be successful as the notion regarding the medicinal use of free phosphorus, viz., "the brain contains free phosphorus, and the more brain work, the more of that element is excreted. Therefore, to restore brain waste, give phosphorus pills." Such a crudity as this would be scouted, even as regards the mineral kingdom, e. g., in the simple, or comparatively simple, operations of metallurgy.

In the second place, the question of quantity may be considered. As a bottle of lithia water contains about 5 grains of lithia, it is chemically equivalent to about 10 grains of soda.

The quantity of blood in an adult being about 100,000 grains and containing about 294 grains of chloride of sodium, equivalent to about 156 grains of soda, it would evidently require 15 or 16 bottles of lithia water to replace the soda by lithia, supposing that sodium salts were absent from the food.

From the quantity and composition of the urine, however, we know that about 140 grains of common salt, equivalent to about 75 grains of soda, are excreted every twenty-four hours, derived, of course, from the food. It follows, therefore, that from 7 to 8 bottles of lithia water would be required every day for the sole purpose of dealing with the sodium salts introduced in the food.

These results are conclusive as to the value of the present practice.

To the chemist, however, the above figures are superfluous. He knows that the tendency is toward the formation of the more insoluble, not of the more soluble, compounds; and that for lithia to be of any service in avoiding deposition of urates in the joints or bladder, all bases which form compounds with uric acid of less solubility than lithic urate (potassium, sodium, ammonium) must be absent.

If we have a solution containing a phosphate, a magnesium salt, and free ammonia, we know that in a longer or shorter time a precipitate of ammonio-magnesic phosphate will take place, and the only way to prevent it is to insure the absence of one of the constituents of the precipitate. We cannot argue "phosphate of potassium is more soluble than ammonio-magnesic phosphate; so by adding a salt of potassium to the solution we shall prevent the formation of the very sparingly soluble magnesium compound," and yet that is the assumption with regard to the medicinal use of lithia water.

It is a chemical exemplification of the truth of the old proverb about one man being able to lead a horse to the water, etc. It would be extremely convenient as regards uric acid patients if lithia water could be made to act in this way, but the laws of chemical combination do not admit of it. The medical profession, therefore, must recognize the fact, and seek elsewhere for a remedy or palliative for their patients.

An analogous case occurred in the gas world, where gas engineers strove for many years to purify the gas from bisulphide of carbon vapor by means of sulphide of calcium; and at the same time, endeavored to make the spent lime inodorous by converting it into carbonate before taking it out of the purifier. Here, again, it would have been very convenient if carbonate of calcium could have been induced to combine with carbon bisulphide, but it is hardly necessary to remark that the attempt was a failure.

Although it is a matter for regret that the science of therapeutics should be in such an elementary stage in the nineteenth century, still the physician is but in the same predicament as the chemist whose work lies in the vegetable or animal kingdoms. Take, for example, the apparently simple question of water analysis. The intellect of the civilized world for fifty years or more has been unable to devise a process (physical, chemical, microscopical, or biological) which will enable the operator to say with certainty, "this water is wholesome." There are several processes which are capable of detecting a bad water, but in many cases this can be done by the senses alone, and so recourse must be had to indirect methods, such as ascertaining the mortality and sickness among the people who use the water, or examining the source as to the probabilities of pollution. Little wonder, then, that medical science is frequently baffled in the attempt to deal with the complex problems of human pathology. Mineral analysis is but child's play compared with the study of morbid actions taking place in closed vessels, suspended in another closed vessel, the walls of all of them being opaque.—Chem. News.

PHOSPHORESCENCE.

Prof. Dewar, in his account of his researches in connection with phosphorescence, gives in explanation of its existence in many bodies, of which, however, phosphorus is not one, the following facts: He found that photographic action does not cease at low temperatures, though it is diminished by eighty per cent. or more. While investigating this he noticed that the apparatus with which he was working was phosphorescing brightly, and he was thus induced to study phosphorescence itself at low temperatures.

Beginning with gelatine and celluloid—substances which he was using in his photographic experiments—he found them to be very luminous when cooled to −180 deg. and exposed for a second to the beam of a strong electric light. In the same way phosphorescence was produced in numerous other organic substances, such as ivory, bone, India rubber, egg shell, feathers, cotton wool, linen, leather, blossoms of flowers, etc. Naturally the question presented itself of the relation of phosphorescence to structure. Prof. Dewar, therefore, experimented with various definite organic compounds and found that one of the most beautiful phosphorescing bodies was the complex salt, the platino-cyanide of ammonium, which shone with a splendid green light. White of egg was brighter than the yelk, while albumen frozen on the outside of a tube and exposed to a light coming through a quartz lens, so that there was no glass to obstruct the ultra-violet rays, phosphoresced with a bright and blue light. From these and other experiments Prof. Dewar is led to the provisional generalization that the more complex a body is in structure, the more likely it is to phosphoresce, perhaps because in some way its structure enables it to take up the light vibrations with the more facility. A very curious point is the enormous effect of the presence of an almost infinitesimal quantity of organic matter. Pure water is weakly phosphorescent, but if it is very slightly impure, it becomes strongly so. A perfectly clean plate of metal does not phosphoresce, but the merest trace of grease—such as is left by a touch of the hand—will make it brightly luminous. The differences which may be caused in the physical behavior of substances by the addition of other substances in infinitesimal quantities is attracting a good deal of attention at the present time. The capability of oxygen for phosphorescing is another curious fact. In the gaseous state it can be made to glow if exposed to an electric spark while rushing into a large vacuum tube. This property is shared by its compounds, but is not possessed by hydrogen or any other gas. Here, strange to say, the presence of a trace of organic matter destroys the effect. Prof. Dewar stated that a drop or two of ether or of scent in the room would make the experiment impossible for hours. That the phosphorescence is due to some kind of molecular change in the oxygen is indicated by the fact that ozone, among other products, is formed during the process.

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